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SUBJECT: Identification of Low-Level Waste Line Leak Sites at Oak Ridge National Laboratory

TO: T. E. Myrick

FROM: H. J. Grimsby

#1951

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5. IDENTIFICATION OF LOW-LEVEL WASTE LINE LEAK SITES AT OAK RIDGE NATIONAL LABORATORY

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January 1986

Prepared by the
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Oak Ridge, Tennessee 37831
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for the
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SUMMARY

Thirty-five sites were identified where leaks or spills occurred during the operation of ORNL's low-level liquid waste system. Excerpts from reports and summaries of interviews are included, where available, for each specific site. In general, there is a scarcity of detailed information pertaining to the exact composition, volume and location of the purported leaks, and details of cleanup efforts, if any, are equally vague.

The thirty-five sites have been categorized into five groups based upon their geographical proximity. Three groups consisting of a total of 23 sites are located within the main complex of ORNL (Bethel Valley) with the remaining 12 sites lying in the Melton Valley region of ORNL.

Estimates of the extent of contamination at most sites will require additional information. Isolated characterization and site performance monitoring will be difficult for those sites located within ORNL's main complex, and remedial actions will be difficult to employ given their location in a heavily congested area. Inclusion of many of the LLW line leak sites with other Remedial Action Program (RAP) sites should be considered; a listing of LLW line leak sites and nearby RAP sites are included.

CONTENTS

1. INTRODUCTION

The low-level liquid waste system [referred to as the Intermediate-Level Liquid Waste System (ILW) until recently] at the ORNL was designed to collect, neutralize, concentrate, and store radioactive waste solutions from the various sources at the Laboratory. During its history, the waste was composed of liquid radioactive waste solutions, other than process wastes, which were produced in hot cells, pilot plants, reactors, and other laboratory facilities and operations. Virtually all of the buildings within the Laboratory which were involved in radionuclide operations were served by this system.

Wastes were discharged from source buildings to 23 collection tanks, located in close proximity to the source buildings (Fig. 1). Nineteen tanks were located in the main Laboratory area in Bethel Valley and 4 tanks were located in Melton Valley. The waste solutions in the collection tanks were periodically transferred to larger storage tanks located near the evaporator annex where it was held until processed through the evaporator for concentration. The concentrated low-level waste (LLW) was then transferred to the storage tanks at the Hydrofracture Facility in Melton Valley (Fig. 2).

During the operational history of the low-level liquid system, leaks and spills have encompassed a broad range of time periods, locations, and leak types. Contamination occurred as far back as 25 to 30 years ago and as recently as the winter of 1985. Many sites are located near the holding tanks serving the LLW line; others along the lines themselves; and still others are not leaks at all but are spills, e.g., from pumping accidents. The contamination extent ranges from the surface for some to as deep as 20 feet for others. The majority of the sites are located close to facilities; however, a few are in remote locations.

The LLW line leak sites are included in the Site Corrective Measures Program (SCMP) and are subject to DOE Order 5480.14, implementation of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). As a part of the SCMP, the objective of this report is to identify sites where leaks or spills have occurred during the operation of the low-level liquid waste system and to assemble the existing information

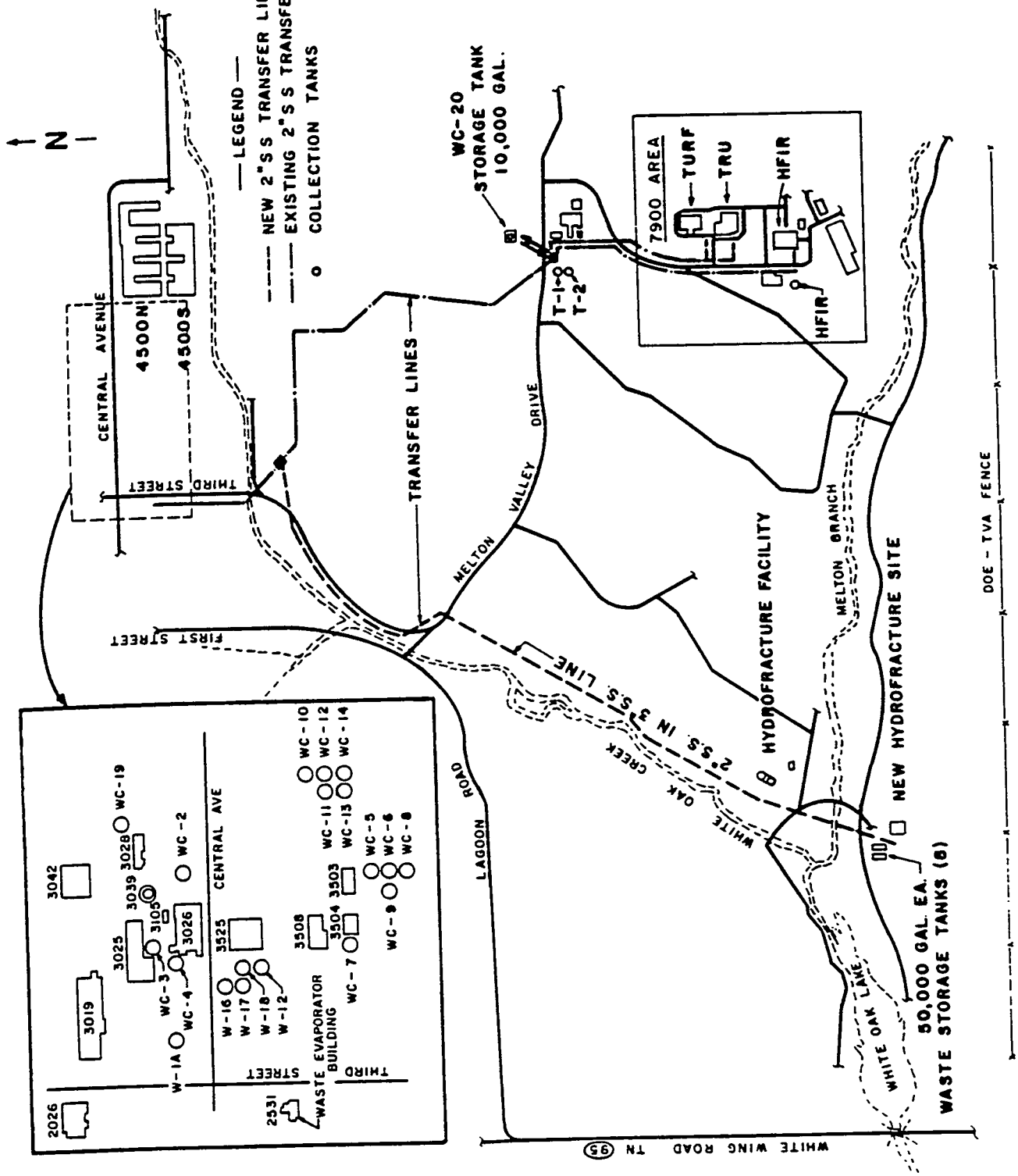

Figure 1. LLW System at ORNL

ORNL DWG 74-8966R

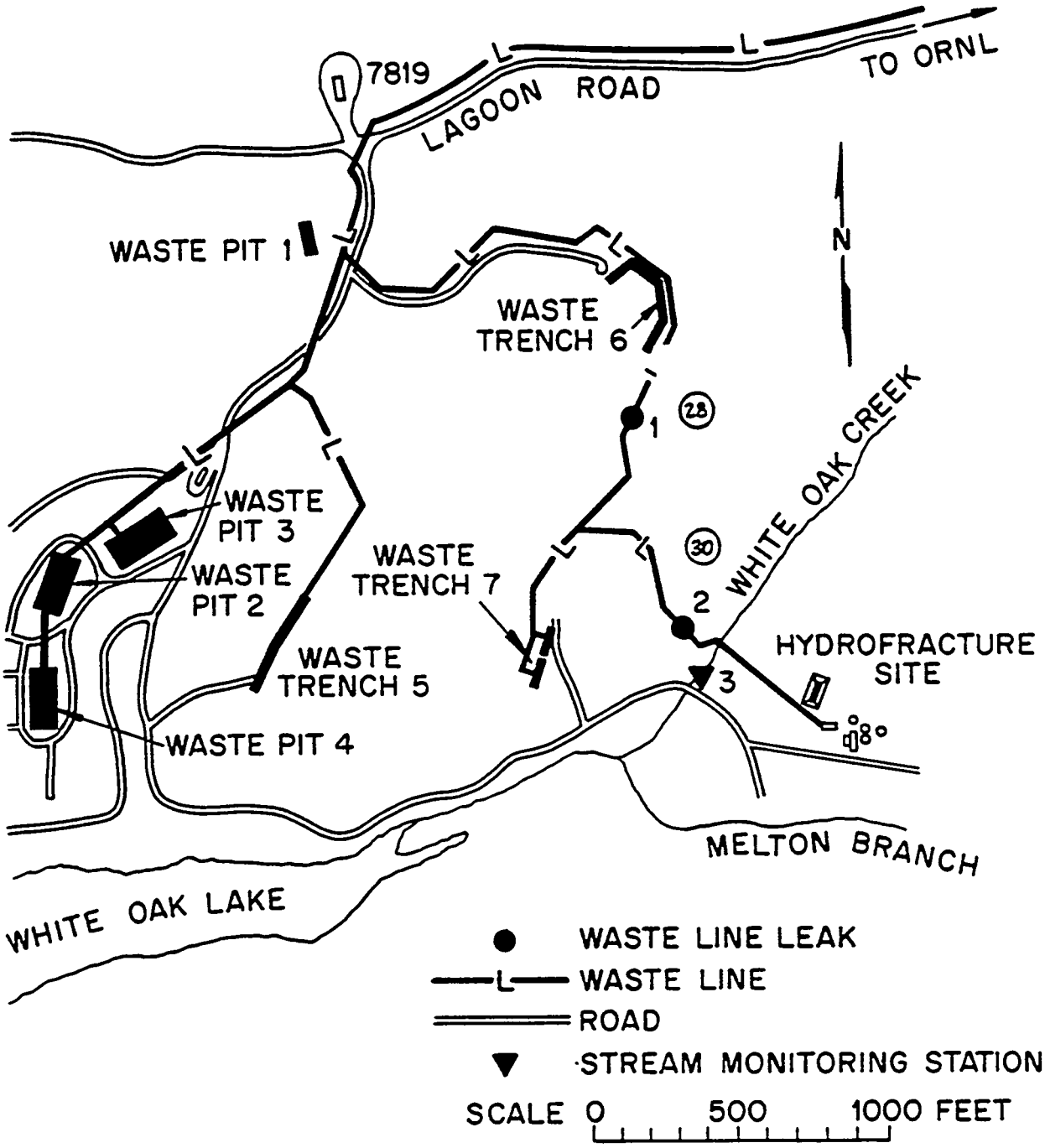

Figure 2. LLW transfer line between ORNL and Hydrofracture Site

information for each specific site. To this end, a literature search was performed using official reports, engineering drawings, and internal correspondence; interviews were conducted with personnel knowledgeable about the operating history of the low-level liquid waste system and plant operations; and site visits were conducted. Appendices A and B provide a summary of the information assembled for this task.

2. BACKGROUND

2.1 HISTORY OF LOW-LEVEL LIQUID WASTE TRANSFER SYSTEM

The first one and one-half mile section of transfer line is a 2" diameter cast iron pipe which was put into operation in June 1954 to transfer waste from the main Laboratory area to Pit 2 (Figs. 1 and 2). A carbon steel extension to reach Trench 5 had been added by 1960, and a further extension out to Trench 6 was added in 1961. By 1962, the Trench 6 lines were extended to Trench 7 and were in service from 1962 to 1965, at which time liquid waste disposal to the pits and trenches was discontinued.

In 1966, a cast iron line was extended to the Hydrofracture Facility. The total length of the line was approximately 1.5 miles. The cast iron line between Trench 7 and the hydrofracture site was replaced in 1971 by a singly-contained stainless steel pipe installed next to the abandoned carbon steel line. The route followed by the pipeline is shown in Fig. 2.

The Melton Valley Transfer line was tied into the system at the intersection of Lagoon Road and Melton Valley Drive as shown in Fig. 3. The line connecting the evaporator system to the Hydrofracture Facility was taken out of service in 1975. It was replaced by a doubly-contained stainless steel line which followed a more direct route as shown in Fig. 1. At the time it was abandoned, the line was flushed with water, purged with air to remove liquid, and capped.

Decommissioning of the low-level liquid waste transfer line was addressed previously by the ORNL SCMP, and resulted in the following activities which are described in more detail by Walls et al.[4]

- o White Oak Creek floodplain section of transfer pipeline was removed.
- o Two leak sites were entombed. (These two sites correspond to Sites 28 and 30 discussed in Sect. 3-1 of this report.)
- o The remaining transfer pipeline was left intact and abandoned, (The Melton Valley transfer line, including the shared portion of the original LLW line, was excluded.)

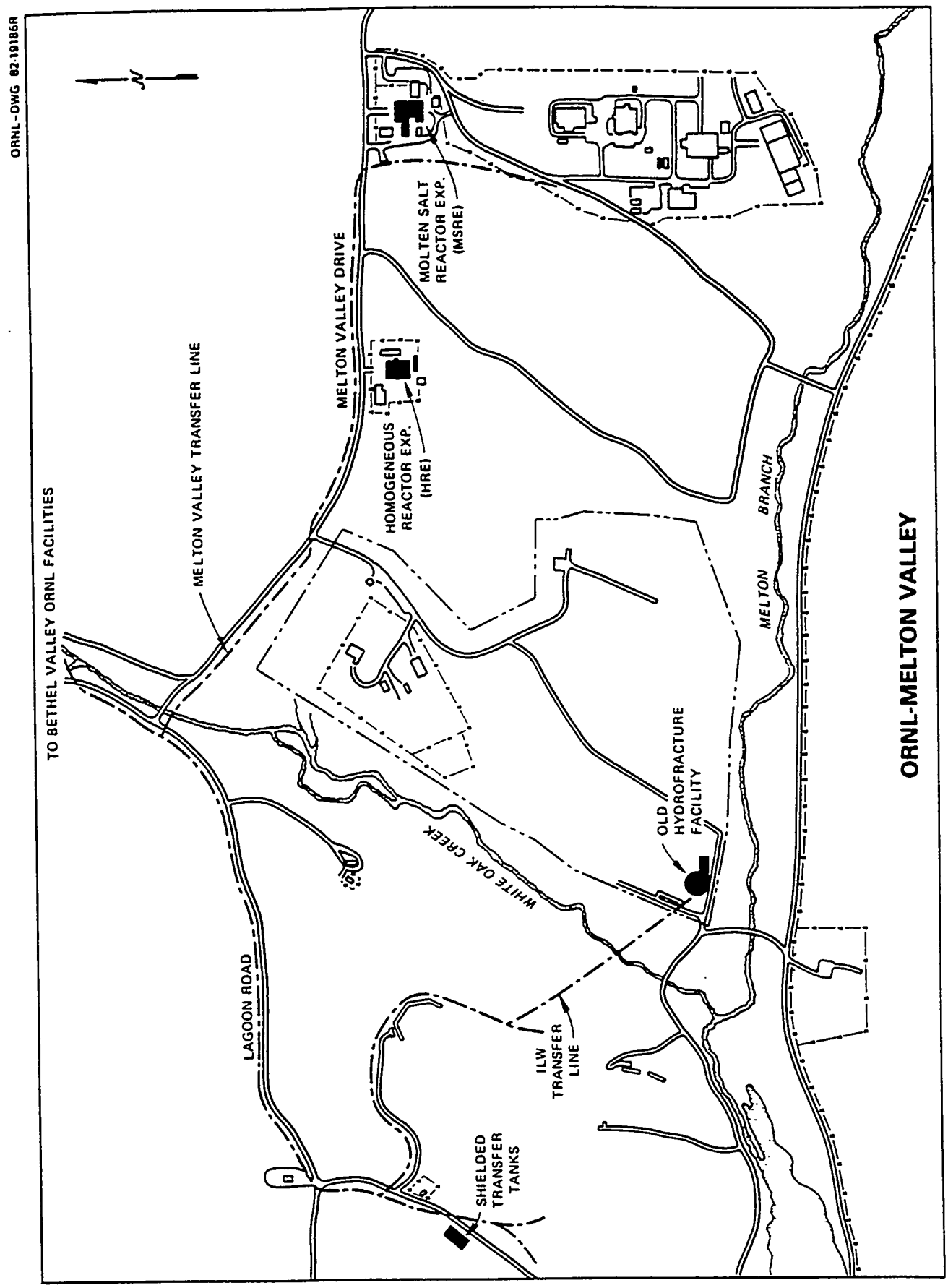

Figure 3. Location map for the LLW (ILW) and Melton Valley Transfer Lines.

2.2 WASTE STREAMS

The total volume and composition of wastes handled by the transfer system have varied along with research and development activities during the operating history of the Laboratory. No effort was made to determine the composition of the waste streams on a routine basis. Most sources generated dilute LLW at millicuries per gallon levels, but several sources generated wastes with concentrations as high as 5 Ci/gal. Still higher level wastes, greater than 20 Ci/gal, were produced in small quantities in operations such as the hot cell and pilot plant processes, but were diluted such that, typically, the resulting wastes contained no more than about 0.05 Ci of beta-gamma activity per gallon.[1] The current average activity in the LLW after collection and intermixing is approximately 30 mCi/gal.[2]

The approximate amount of materials handled by these lines can be inferred from the radioactivity inventories of the pits and trenches:[3]

Pits, 2, 3, and 4	5×10^5 Ci
Trench 5	3×10^5 Ci
Trench 7	2.8×10^5 Ci

During 1952 and 1975, the transfer line conveyed over 45×10^6 gallons of liquid waste containing some 1.5 MCi of mixed fission products to Melton Valley disposal facilities.[3] A preliminary estimate of the current inventory in Trench 7 indicated the following activities:[2]

^{137}Cs	1.5×10^5 Ci
^{90}Sr	3.2×10^4 Ci
^{60}Co	1.7×10^2 Ci
^{237}Pu	9.2 Ci
^{233}U	3.2 Ci
Alpha-emitting nuclides	< 1 Ci

During more recent years, the total activity handled by the system has been estimated to be in the order of 3.5×10^4 to 5.5×10^4 beta-gamma curies per year, with the major radionuclides present being ^{90}Sr, ^{137}Cs, ^{106}Ru, ^{60}Co, and various rare earths. The annual alpha activity varies also but was estimated by Binford and Orfi[1] to be 80 Ci based upon analyses of hydrofracture feed reported in 1979, attributed primarily to ^{244}Cm. The wastes were primarily aqueous in nature but

also contained small quantities of organic residues from operations such as decontamination. The wastes generally originated as nitrate solutions, but some were acid chlorides or other corrosive agents. Sodium hydroxide contained within the collection tanks was used to neutralize the wastes before transfer to the evaporator collection tanks. Sodium hydroxide and sodium nitrate comprised approximately 75 per cent of the nonradioactive chemical contents, and the total solids ranged from 5 to 10 grams per liter.

3. CONTAMINATED LEAK SITES

3.1 LOCATIONS

Thirty-five sites were identified where leaks or spills occurred within the transfer system. A listing of these sites is found in Table I. To aid in planning and reporting, the LLW line leak sites are separated into five groups based primarily upon geographical proximity, since the contamination is by definition low-level waste and, therefore, is similar for all sites. General site maps giving the approximate locations for these sites are found in Figs. 4 and 5.

Twenty-three of the leak sites are within ORNL's main complex with 20 of the 23 sites being concentrated in the 3000 and 3500 blocks which are divided by Central Avenue (Fig. 4). The contamination is predominantly subsurface; however, surface contamination has occurred in some cases. Contamination has been reported underneath Buildings 3047, 3026, 3515, and 3550, and there is a high probability of contamination under other buildings in the General Isotopes area. Contamination is frequently due to leaks around transfer line and tank junctions where in some cases contamination has been detected as much as 20 feet below grade. Much of the sanitary sewer contamination, listed as site 16, results from crossovers to the system from areas of LLW line leaks and spills in the main area.

The leaks and spills in the Melton Valley area of ORNL are generally along either the ILW or Melton Valley Transfer Line, with isolated incidents occurring during hydrofracture operations. Many of the Melton Valley, as well as the Bethel Valley, sites are located near other Remedial Action Program sites.

In general there is a scarcity of detailed information pertaining to the composition, volume, and location of the contaminated materials at each site; however, based on inventories obtained for the pits and trenches serving the LLW system and for two sites addressed during the decommissioning of the ILW Transfer Line, the major radionuclide contaminants are expected to be ^{137}Cs, ^{90}Sr, and ^{60}Co (Sect. 2.2). The specific site information gathered from literature and interviews is contained in Appendix A.

Table I. LLW Leak Sites by Groups

Group 1 - Bethel Valley: 3019 Area

Site 1 - Bldg 3020, South
Site 2 - Bldg 3020, East
Site 3 - Bldg 3082, West
Site 4 - Bldg 3019, North
Site 5 - Bldg 3019, Southwest

Group 2 - Bethel Valley: Isotopes Area

Site 6 - Bldg 3110, Between WC-5 and WC-19
Site 7 - Bldg 3047, Underneath
Site 8 - General Isotopes Area (3037, 3033, etc)
Site 9 - Bldg 3092 area
Site 10 - Bldg 3026, Underneath
Site 11 - Bldg 3024, Between WC-1 and WC-5
Site 33 - Bldg 3085, North
Site 34 - Bldg 3042, Decay Tank Area

Group 3 - Bethel Valley: South of Central Avenue

Site 12 - Bldg 2531, East
Site 13 - Bldg 3515, Underneath
Site 14 - Bldg 3525, To a sump
Site 15 - Bldg 3550, Underneath
Site 16 - Bldg 3500, Sewer
Site 17 - Abandoned line Central Avenue Area
Site 18 - Bldg 4508, North
Site 19 - Bldg 3518, West
Site 20 - Northwest of SWSA-1
Site 35 - Bldg 3503, Ground Contamination

Group 4 - Melton Valley: Melton Valley Drive Area

Site 21 - Lagoon Road and Melton Valley Drive
Site 22 - Melton Valley Drive and SWSA-5 Access Road
Site 23 - 7500 Area
Site 24 - West of Melton Valley Pumping Station
Site 25 - Bldg 7920 and Melton Valley Pumping Station Area
Site 26 - Bldg 7920 ditch line
Site 32 - The Melton Valley Transfer Line

Group 5 - Melton Valley: Burial Ground Area

Site 27 - Hydrofracture No. 1 - Release of grout
Site 28 - Pit 6 - Southeast
Site 29 - End of Trench 7 Access Road
Site 30 - Gaging Station, Northwest of Bldg 7852
Site 31 - Bldg 7852 - Hydrofracture Injection Area, South

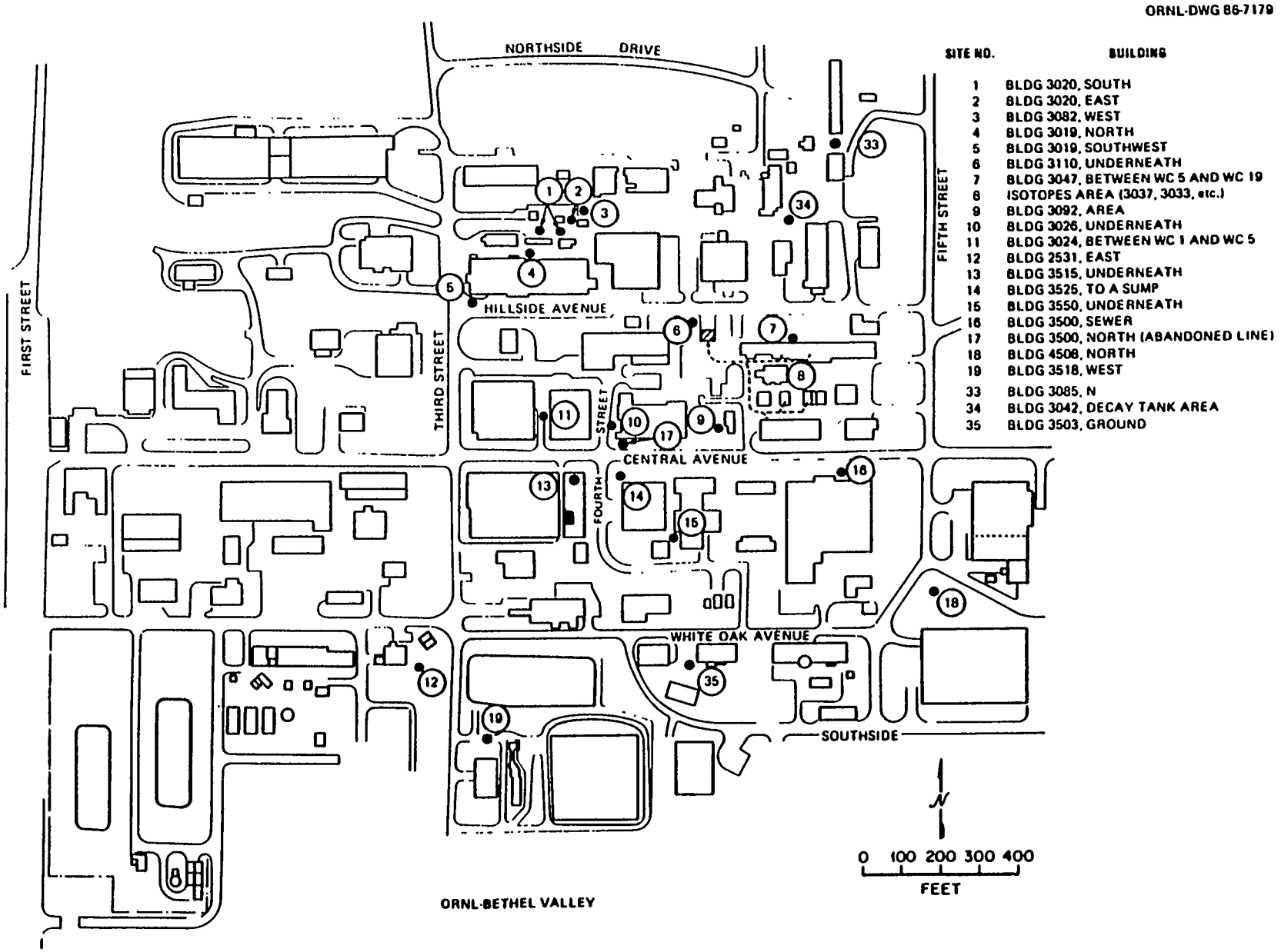

Figure 4. Location of LLW Leak Sites in the ORNL Main Complex.

SITE NO.

21 LAGOON ROAD AND MELTON VALLEY DRIVE
22 MELTON VALLEY DRIVE AND SWSA-5 ACCESS ROAD
23 7500 AREA
24 WEST OF MELTON VALLEY PUMPING STATION
25 BLDG 7920/MELTON VALLEY PUMPING STATION AREA
26 BLDG 7920 DITCH LINE
27 HYDROFRACTURE NO. 1 – RELEASE OF GROUT
28 PIT 6 – SOUTHEAST
29 END OF TRENCH 7 ACCESS ROAD
30 GAGING STATION NORTHWEST OF BLDG 7852
31 BLDG 7852 – HYDROFRACTURE INJECTION AREA (SOUTH)
32 MELTON VALLEY TRANSFER LINE

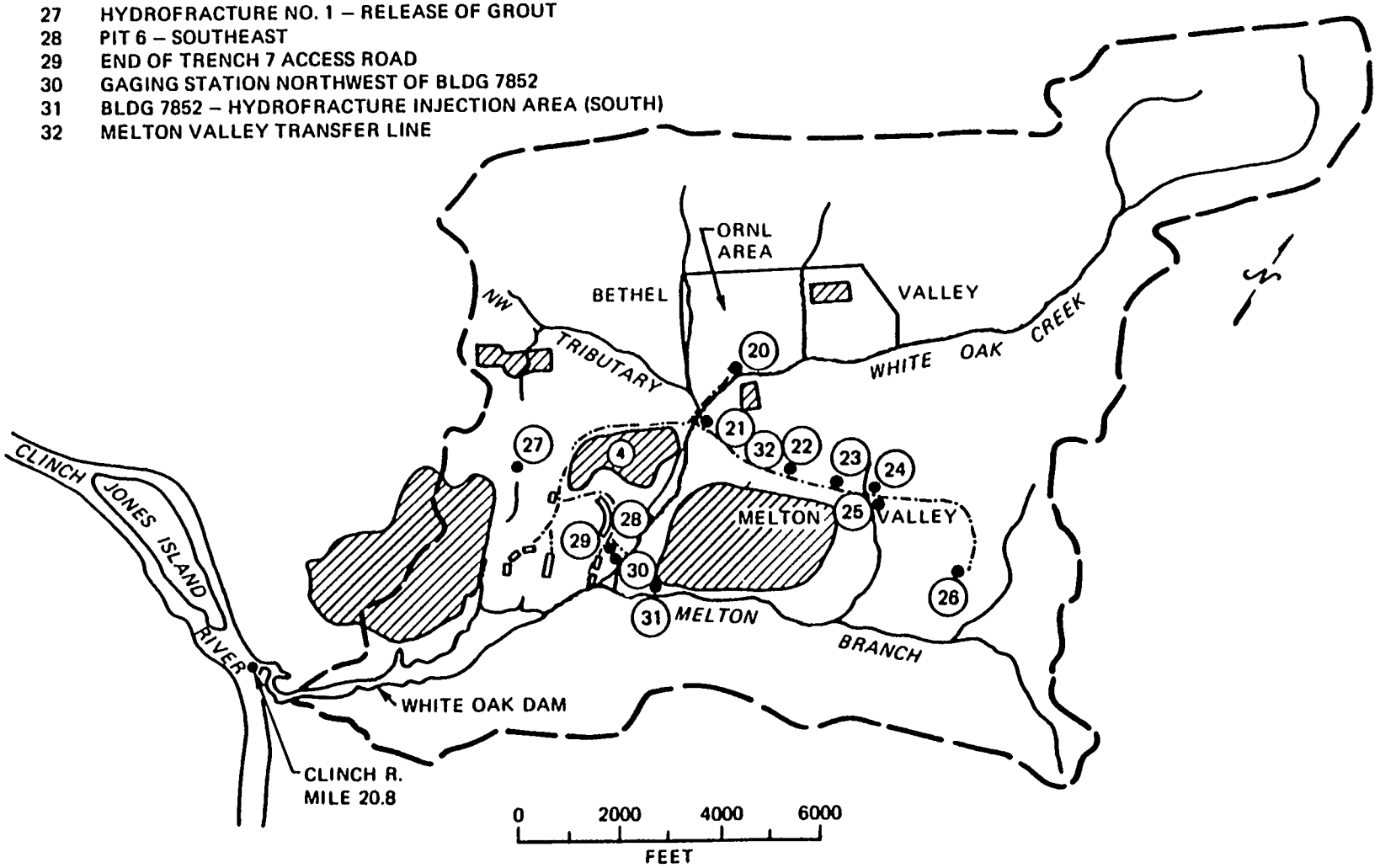

Figure 5. Location of LLW Leak Sites in Melton Valley.

3.2 REGULATORY STATUS

The LLW line leak sites are subject to DOE Order 5480.14, implementation of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and to Clean Water Act regulations.[5] The sites were considered as a group for the preparation of the modified Hazard Ranking System (mHRS) worksheets.[6] The migration score, S_m, as determined by the mHRS was 3.88, a score lower than many of the other ORNL Remedial Action Program sites such as the LLW pits and trenches. The parameter, Sm reflects the potential for harm to humans or the environment from migration of a hazardous substance away from the facility by routes involving groundwater, surface water, or air. It is a composite score for each of the three routes. The main factors in the scoring were:

* No specific information known regarding type and quantity of contaminants
* Releases to groundwater and surface water have been observed
* No airborne contamination observed; airborne migration scores zero
* Groundwater migration routes score zero (for all ORNL sites)
* Radioactivity value is 1 based on ^{90}Sr, quantity unknown
* Chemical toxicity is based on ^{90}Sr (toxicity = 2, persistence = 3)

Since groundwater and airborne migration routes score zero, surface water migration is the only contributor to the S_m score. Based on the chemical toxicity, a relatively high waste characteristic score is generated for the LLW line leak sites, but the total target score associated with the surface water routes is low based on the following component scores.

Surface water use, i.e. use being made of surface water downstream from the facility and within a distance of three miles from the location of the hazardous substance, includes irrigation and recreation but does not include use as drinking water. It has an assigned value of 2.

Distance to a sensitive environment refers to the distance from the hazardous substance (not the facility boundary) to an area containing an important biological resource or to a fragile natural setting that could suffer an especially severe impact from pollution. The distance

to wetlands and critical habitats of endangered species is greater than one mile and, therefore, has an assigned value of zero.

Population served by surface water with water intake 3 miles downstream from facility is an indicator of the potential hazard exposure of the nearby population served by contaminated surface water. The distance is measured from the probable point of entry into surface water and follows the surface water flow (i.e. stream miles). This distance is greater than 3 miles and receives a value of zero.

Changes in target factors associated with groundwater or surface water routes should not change the relative ranking of the LLW line leak sites with respect to other ORNL Remedial Action Program sites since these target factors would change for all sites.

In addition to the S_m score, the potential for harm from substances that can explode or cause fires, S_{fe}, and the potential for harm from direct contact with hazardous substances at the facility, S_{dc}, were determined. For the LLW line leak sites, there is no documented fire or explosion hazard, i.e. S_{fe} equals zero. The direct contact factor of 33.3 is relatively high. It is based on maximum ratings in the assessibility and containment areas and a high value assigned for the target population within a one-mile radius. (Sites in Groups 1, 2, and 3 are located in congested areas within the ORNL main complex.)

3.3 REMEDIAL ACTION INVESTIGATIONS

Remedial actions for the LLW contaminated areas would concentrate on limiting groundwater and surface water migration as well as direct contact. Remedial actions for locations in Bethel Valley must consider strongly that these sites are in a heavily congested plant area and are, as in the case of contamination being located underneath buildings, inaccessible without massive demolition. Melton Valley sites, however, are relatively isolated in nature.

Estimates of the extent of contamination at a given site are virtually impossible given current information. For most of the sites, uncertainty exists as to when and where a leak began, how long it lasted, and how

extensive was the resulting contamination, making it difficult to arrive at any accurate estimate of contaminant inventory and volume. Remedial actions would first, therefore, have to locate the boundaries of these sites, and then to estimate the extent of contamination in each of these areas.

Due to the close proximity of these sites to other Remedial Action Program sites, isolated characterization and site performance monitoring on each individual site will be difficult to perform. In addition, some of the LLW leak line sites in Groups 1, 2, and 3 will tend to influence each other.

Preliminary studies and planning activities are currently underway for the Group 1 sites, the 3019 area. A copy of the personal correspondence between D. D. Huff and T. E. Myrick dated October 7, 1985, reporting in a summary of work completed to date is included in Appendix B. In addition, plans for site 3028 are being developed and should consider inclusion of Group 2 sites where possible.

LLW line leak sites which could be addressed with other nearby Remedial Action Program sites include:

LLW Line Leak Site	Remedial Action Site Nearby
Site 19	3524, Equalization Basin 3513, Waste Holding Basin
Site 35	3503, Mercury spill and Storage Pad
Site 19	7500, HRE Pond and Facility
Site 26	7810, Pit 6
Site 29	7818, Trench 7
Site 30	0853, White Oak Creek Floodplain
Site 31	7852, Hydrofracture Site

Group 4 consists of sites along and including the Melton Valley Transfer Line (MVTL). With the exception of Site 23, the 7500 area contamination, the sites do not appear to be located near other Remedial Action Program sites; however, it is feasible to include all Group 4 sites in the MVTL remedial action plans.

The LLW transfer system at ORNL seems to represent a myriad of modifications and corrections which have transpired over approximately 40 years of operation. Given the lack of information available on the 35 sites found to date, future incidents of uncovering/discovering "hot-spots" while excavating, especially in ORNL's main complex, should be expected; it is probable that others will be found during site characterization activities.

4. REFERENCES

1. F. T. Binford and S. D. Orfi, The Intermediate-Level Liquid Waste System at the Oak Ridge National Laboratory Description and Safety Analysis, ORNL/TM-6959, August 1979.

2. T. E. Myrick, The ORNL Surplus Facilities Management Program Long Range Plan, ORNL/TM-8957, September 1984.

3. W. F. Ohnesorge, et al, An Environmental Radiological Survey of the Intermediate Level Waste System Pipeline, ORNL/TM-7858, September 1981.

4. A. A. Walls et al., The Intermediate Level Waste Transfer Line Decommissioning Project-Final Report, ORNL/TM-8897, December 1983.

5. R. E. Saylor and L. D.Voorhees, Oak Ridge National Laboratory Remedial Program Action Plans for Regulatory Compliance, Letter Report RAP86-6, December 1985.

6. C. E. Nix, Personal Communication to H. J. Grimsby, January 1986.

APPENDIX A

Site-Specific Information for LLW Line Leaks

LIST OF FIGURES

APPENDIX A

SITE-SPECIFIC INFORMATION

For those sites listed in Table I, the information gathered from literature and interviews is assembled in the following section. Excerpts from reports and summaries from interviews are included for each specific site. In general, there is a scarcity of detailed information regarding leakage composition, volume, location, and extent of cleanup efforts. Where past reports infer a leak occurrence in an area, excerpts have been included such that these areas may be considered for remedial action.

GROUP 1

Group 1 consists of sites 1 through 5 which are located in an area around Building 3019 in the ORNL main complex (see Fig. 1). The buildings used as reference locations for leak sites in this area include:

3019A	Radiochemical Processing Pilot Plant
3019B	High Level Radiation Processing Laboratory
3020	Exhaust Stack for 3019
3074	Interim Manipulator Repair Facility
3091	Filters for 3019
3108	Cell and Hood Ventilation Filters for 3019

Site 1 - Leak Located Due South of Building 3020

(The following information is a summation of an interview with ORNL Operations Division personnel.)

A low level waste line leak occurred due south of the Building 3020 stack. The line served Building 3108 and leaks occurred at the vent stack and the valve pit areas. The initial leak occurred in the mid-1970s when a site glass in the header froze and broke. Later a restriction downline caused a backup to occur with overflow at both locations. The Building 3108 filter pit has a very wide range of radionuclides (Pu, Sr, Cs, etc.). Leakage from this site, from overflows which have occurred, has also contaminated the storm drainage system north of Building 3074 from east to west.

Site 2 - Leak Located East of the Building 3020 Stack

(The following information is a summation of an interview with ORNL Operations Division personnel.)

The leak is believed to have occured some 25 years ago, possibly from exhaust gas duct leakage. A 1970 contamination survey of the area

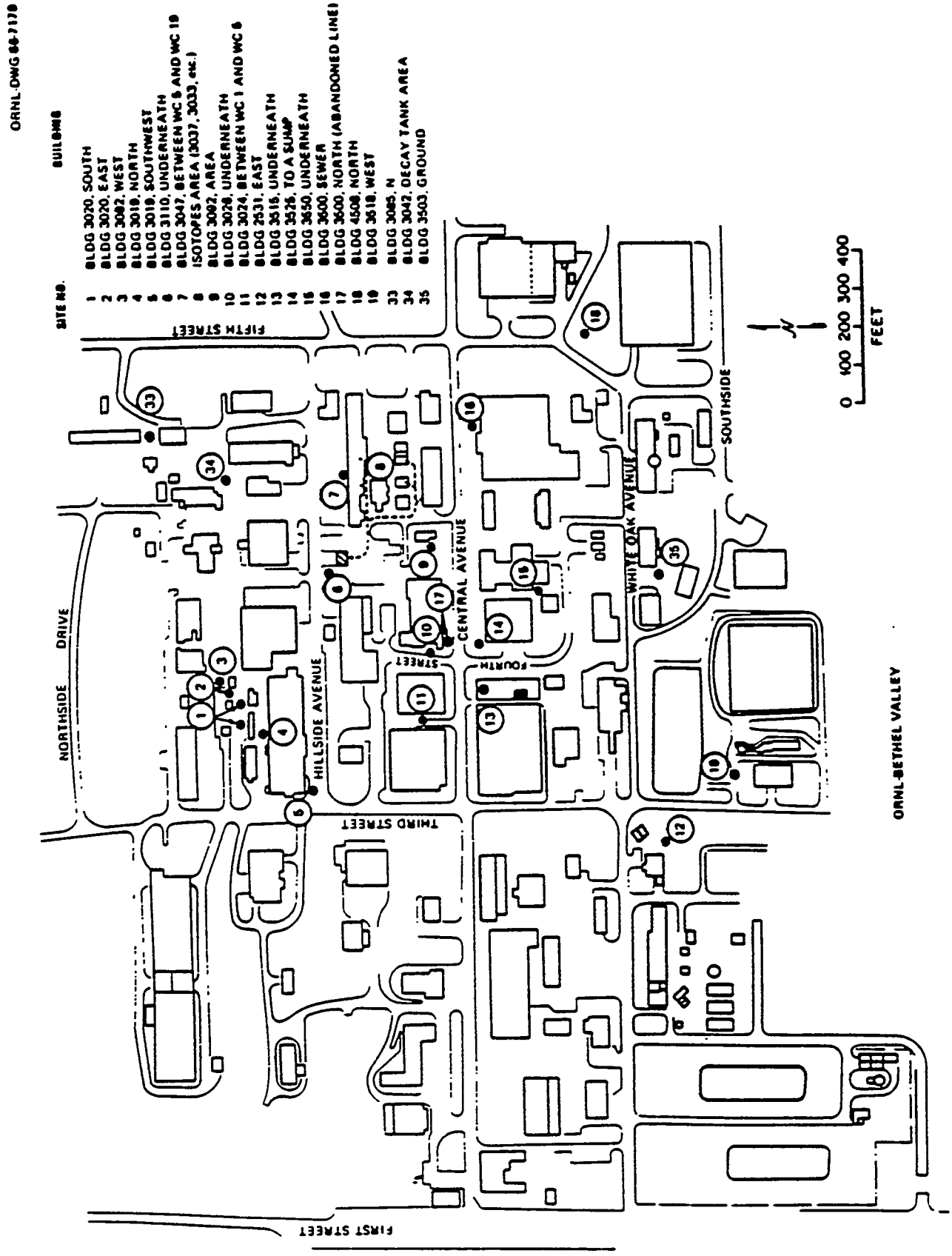

Figure 1. Location of LLW Leak Sites in the ORNL Main Complex.

showed 20 mR/hr on top soil and alpha readings at 10 mR/hr. Most of the contamination is in the soil and concrete pad.

Site 3 - Leak Located West of Building 3082

(The following information is a summation of an interview with ORNL Operations Division personnel.)

This leak was thought to have occurred over 25 years ago. Readings in the area ran 1-2 mR/hr in 1970's surveys. The contamination was most probably caused by off-gas duct leakage or a LLW line leak; however, no documentation is known to exist regarding source. This site is also close to the location of an old plutonium facility which was housed in a wooden frame building. The building was destroyed early in the history of ORNL and is not listed on current maps. The area contamination may or may not be affected by the past presence of this building.

Site 4 - Leak Located North of Building 3019 (West of the Bldg. 3074/3019 Gate)

(The following information is a summation of an interview with ORNL Operations Division personnel.)

A low-level waste line leak occurred in a concrete encased chemware line that served the manipulator shop upstream and the Bldg. 3020 stack; the line/header had deteriorated over time. There is no real estimate of the period of leakage; however, the leak was discovered in February 1985 after ^{90}Sr was found to be in the sewer system at higher than normal levels. The leak occurred at the T in the line. Upon excavation, there was found to be a cavern in the area. Excavation was provided for access to the leak; no attempt was made to remove all the contaminated soil in the area. The contaminated earth removed (100 mR/hr maximum) was disposed and the excavation was backfilled with clean earth after the north and south lines into the T were capped.

Site 5 - Leak Located at the Southwest Corner of Building 3019

(The following information is a summation of an interview with ORNL Operations Division personnel.)

This leak is located in the LLW line draining the analytical cells in Building 3019. The leaks occurred in the 1970s with the last leak apparently occurring in 1978. After the last occurrence the leak was corrected, soil was removed during the corrective action only to the extent of making repairs. Samples of the soil removed at that time measured 100 mR/hr. The line was known to contain ^{90}Sr, ^{60}Co, mixed fission products and alpha emitters.

The following report excerpt indicates a leak in the 3019 area which probably corresponds to Site 5:

Rust Engineering Company personnel excavated a portion of the radiochemical waste drain serving the HRLAF cells to permit tie-in of the rerouted cask transfer tunnel drain Highly contaminated soil was encountered in the vicinity of a leak at a weld in the existing line. Careful monitoring and stringent contamination control procedures were required. The leaking drain was repaired by ORNL craftsmen.[1]

GROUP 2

Group 2 consists of sites 6 through 11, 33, and 34 and is the General Isotopes Area in the ORNL main complex (see Fig. 1). The area is located near Central Avenue. The buildings used as reference location for leak sites located in this area include:

3025A	Solid State Division Laboratories
3025B	Physical Examination Hot Cells
3026C	Radioisotope Development Laboratory
3026D	Dismantling and Examination Cells
3029	Radioisotope Production Laboratory - B
3030	Radioisotope Production Laboratory - C
3034	Radioisotope Area Services
3037	Isotopes Division Offices
3038	Radioisotope Laboratory
3042	Oak Ridge Research Reactor
3047	Isotope Technology Building
3085	ORR Pumphouse
3092	Off-gas Facility
3110	Cell Ventilation Filters for Radioisotope Area

Site 6 - Leak in Transfer Line between WC-5 and WC-19

This site was included in a tabulation of contaminated areas dated January 31, 1972. The writeup for the site, keyed to engineering drawing A-90015-Ø-0063-F Rev(0), stated the following:

> On Oct. 16, 1972, a leak in the WC-5 to WC-19 transfer line at a point 30 feet east of NE corner of Bldg. 3025 and 45 feet from south edge of Hillside area contaminated an area with ^{115}Cd, ^{141}Ce, ^{140}Ba, ^{95}Nb (all known contaminants in ORR coolant). Cutie Pie readings of 700 mR/hr were noted in the steam leak area (in earth around leak) and readings of 20 to 600 mr/hr were found in mud in a half-round drain tile extending eastward to a storm sewer catch basin.

Site 7 - Contaminated Area Underneath Building 3047

This site has suspect underground contamination due to its history of operations. Few documented cases were found in laboratory records; however, intra-laboratory correspondence (see Appendix B) document part of the presence of contamination in this area.

Witkowski, in the 1969 Annual Report on Radioactive Waste Control and Release at the Oak Ridge National Laboratory[2] lists the amount of radioactivity discharged into the Process Waste System from this source as 4.1 curies indicating contamination in this area.

Site 8 - Contamination in the General Isotopes Area

The General Isotopes Area is located around Buildings 3034, 3037, and 3038. This general area is known to be contaminated with ^{137}Cs, ^{60}Co, ^{106}Ru, and ^{90}Sr radionuclides and possibly mercury. The contamination of the surrounding area ground is from leaks and spillages encountered during operations of the 1950s and 1960s. Few documented cases were found in laboratory records; however, intra-laboratory correspondence (see Appendix A.1) document contamination in this area.

In addition to the correspondence found in Appendix A.1, excerpts from reports, such as the following, give support to the likelihood of contamination existing in this area.

> ...(the increased discharge to White Oak Lake) is attributed to a decrease in rainfall during the month and the completion of repair work on leaking waste lines in the Radioisotopes Processing Area.[3] (April 1962)
>
> There were two accidental releases of Promethium-147 in the Isotope area. One resulted from a spill in the radioisotope storage barricade and the other from decontamination of the vacuum lines. The drain in the barricade is to be rerouted to the "hot" waste system to prevent similar occurrences in the future.[4] (April 1959)
>
> Approximately 70 curies of Promethium-147.....were discharged to White Oak Creek from the Process Waste Treatment Plant.[4] (April 1959)
>
> A leak occurring at a valve in monitoring tank WC-10 released an estimated 300 millicuries of ^{90}Sr to White Oak Creek. This release accounts for a part of the activity seen at Monitoring Station No. 2. The necessary repairs were made without delay and normal operation resumed.....As noted in the preceeding section, 0.3 curies originated at a leaky

valve in the ILW system;[5] (August 1962) (WC-10 serves the General Isotope Area.)

The leak into the Fifth Street branch of the creek is still being investigated. The most recent sampling data obtained indicate that the activity is seeping into a storm sewer running north to south between the Radioisotope and the 3039 Stack areas. This sewer joins the Central Avenue sewer that runs east to the Fifth Street branch of the creek. The activity appears to be seeping into the storm sewer from the soil around waste tank WC-2; this soil was contaminated at one time by a leak from a broken sampler line from that tank.[2] (1969)

Approximately 5 curies...was the result of a minor spill from the cesium production equipment in Building 3029.[5] (February 1954)

...and the corrosion of a hot-waste line in the Radioisotope Area from Building 3030 which resulted in a leak into the process waste line located nearby.[7] (June 1954)

In addition, Witkowski in the 1969 Annual Report on Radioactive Waste Control and Release at the Oak Ridge National Laboratory[2] lists the amount of radioactivity discharged into the Process waste system from this source as 4.3 curies.

Site 9 - Contamination Located Around 3092

This site was included in a tabulation of contaminated areas dated January 31, 1972. The writeup for the site keyed to engineering drawing A-90015-Ø-0063F Rev(0), stated the following:

(A) spill (occurred) onto grass along side of Building 3092. (It was) dug up and replaced with clean dirt.

Site 10 - Contamination in the 3026 Area

The ground beneath and around Building 3026 is likely to be contaminated from leaks and spillages which occurred from operations during the 1950s and 1960s. Little quantitative data were found; however, the site has suspect contamination based on the following references from Operations Division reports. From the nature of operations during its long history, Building 3026 area contamination could include isotopes of uranium, fission products, and transuranics.

The quantity of activity discharged into White Oak Creek by the settling basin this year was practically the same as that discharged in 1950. Of the total 169 curies sent to the Creek, less than 7.2 curies was contributed by the waste evaporator; almost the entire balance of the activity came from the process-waste system as a result of difficulties encountered in operation and the lack of control of wastes

entering the process-waste system. The known difficulties that were traced to operations were the fission-product separations process in Building 3515, an underground leak west of Building 3026, and the pile canal in Building 3001. These difficulties contributed roughly 65 curies, or 38% of the total discharged to the Creek...[8] (April 1952)

The leaking underground cell-ventilation duct from Building 3026-C was replaced with an above-ground duct. The remaining leaks in the hood-ventilation duct in the radioisotope area were caulked and cemented.[9] (May 1952)

A leak of radioactive material from a metal-waste line of Building 3026-D into a valve pit that drains to the settling basin occurred on July 31, but the total discharge from this source is not included in this month's calculated discharge.[10] (July 1952)

The beta activity discharged to White Oak Creek from the settling basin and retention pond is greater than that of last month and is attributable principally to two leaking waste lines in a pit west of Building 3026-C. The leaking material was the highly radioactive waste from the RaLa runs. (August 1952)

RaLa (^{140}Ba/12.5 d). During the run the metal-waste discharge line from Building 3026 started leaking into the valve pit west of Building 3026-C This leak accounts for most of the excess activity discharged into White Oak Creek this months.[11] (August 1952)

The leak, which started last month, in the chemical-waste line from Building 3026 was repaired early in this month.[12] (September 1952)

A total of 48.0 curies of beta activity was discharged to White Oak Creek from the settling basin and the retention pond; this discharge is 29% greater than the average for the year-to-date and was the result of two leaks in the waste lines (in the pit west of Building 3026-C) which carried the wastes from the RaLa runs. Necessary repairs will be made as soon as the pit is decontaminated sufficiently to allow an adequate amount of working time.[13] (November 1954)

A total of 18.87 curies of beta activity was discharged to White Oak Creek from the settling basin and the retention pond; this discharge is 53% of the average for the year-to-date. The leaks in the metal-waste and the chemical-waste lines from Building 3026-D which accounted for most of the discharge last month have been repaired.[14] (December 1953)

The second largest known single source of activity was the valve pit on the west side of Building 3026 through which the RaLa wastes pass. About 35 curies of activity were discharged to the settling basin in November when two leaks developed, one in the chemical-waste line and the other in the metal-waste line.[15] (1953)

A total of 23.75 curies of beta activity was discharged to White Oak Creek from the settling basin and the retention pond. This discharge is 66% of the monthly average for last year and 126% of that of last month. The increase over last month can be attributed to several causes:

1. Recurrence of a leak in the chemical-waste line in the pit pit west of Building 3026.[16] (January 1954)

The activity in the storm sewer discharge seeped into an abandoned section of clay pipe from contaminated soil around the process waste equalization basin. The activity in the sanitary sewer came mainly from in-leakage under Central Avenue in front of Building 3026, although some traces of activity have also been found in the sewer running east to west on the north side of Building 4508. The leak into the sewer in front of Building 3026 was undoubtedly from earth contaminated by an old intermediate-level waste line that leaked and was taken out of service years ago.[2] (1969)

In addition, Witkowski in the 1969 Annual Report on Radioactive Waste Control and Release at the Oak Ridge National Laboratory[2] lists the amount of radioactivity discharged into the Process waste system from Buildings 3025 and 3026 as 0.28 curies.

Site 11 - Spill in the Building 3024 Area (Between WC-1 and WC-5)

This site was included in a tabulation of contaminated areas dated January 31, 1972 and keyed to engineering drawing A-90015-Ø-0063-F Rev(0). The site was reported as a break in the transfer line between WC-1 and WC-5. Excerpts from Operations Division Reports reporting leaks from various tanks in this area and contributors to contamination in this area are included below. Figure 2 is provided to show the location of the various LLW collection tanks in the main plant complex.

A new gasket was placed in the connecting flange to the outlet valve from tank W-1, and the connecting flanges to the outlet tank W-2 were tightened. Leaks had been found at these places, which were undoubtedly contributing to the high activity discharged from the retention pond.[17] (November 1952)

A large leak was again found at the flange of the W-1 tank outlet valve. A new gasket was installed in this flange last month, but it failed to hold because the wrong size had been

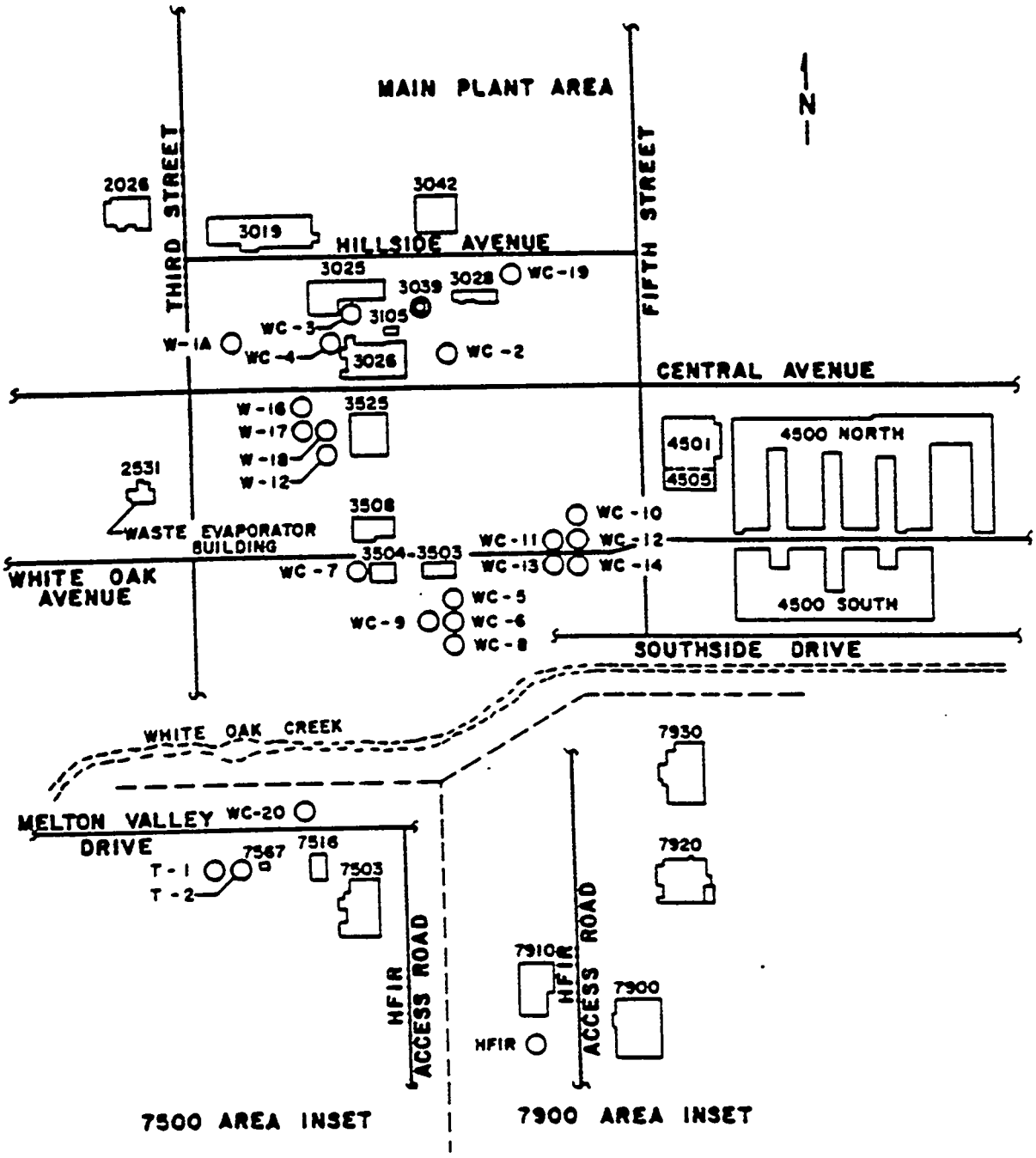

Figure 2. Map showing the location of the LLW Collection Tanks.[18] (Not to scale)

used. In an effort to locate the leakage of activity to the retention pond, the following steps were taken:
1. Tanks W-1 and W-2 were thoroughly tested for leaks. It was found that tank W-1 does leak but not in sufficient quantity to cause the high retention pond discharge. However, W-1 has been removed from service.
2. The outlet line from the W-1 and W-2 diversion box to tanks W-1 and W-2 was uncovered from the diversion box to the Y in the lines above the tanks; no leaks were found.
3. Test holes are being drilled in the area adjacent to the route of the hot-waste line from Building 3019 to tank W-5, particularly where this line comes near the retention-pond line, since it seems probable by the analysis of retention-pond discharge that a leakage from this line may be finding its way into the retention pond system.[19] (December 1953)

The discharge of activity into White Oak Creek from an unknown source through the retention pond continued at a high rate this month. By extensive excavation of the pipe lines connected to the retention-pond system in the north tank farm and by repeated measurements of flow and activity entering the main line from the various tributaries, it was determined that the major portion of the total activity was entering the system in the vicinity of tanks W-3 and W-4. Efforts to determine the exact source of this discharge will be continued.[20] (January 1953)

The discharge of activity into White Oak Creek from an unknown source through the retention pond was at a high rate again this month. Excavations were made that uncovered the outlet lines from tanks WC-3 and WC-4, the lines from tank W-14 to valve group IV, and the lines from valve group IV to Central Avenue, but no leaks were located.
Holes were drilled to a depth of 20 ft around tanks W-4 and W-4 in an effort o determine the pattern of this hot-waste flow. To date, the activity has been encountered in areas just south of tank W-4.[21] (February 1953)

After many weeks of extensive excavation in the north tank farm in search of the source of activity discharged into the retention pond, a serious leak was discovered in valve group no. 1 which appeared to have contributed the bulk of the activity. Highly contaminated earth was found as far as 13 ft below the surface when holes were drilled around this valve group. Water that was added to these holes flowed underground toward tanks W-3 and W-4, where earth was found to be highly contaminated at a depth of 20 ft. The activity at this point was proved, by a series of tests, to be seeping into the retention pond system through loose joints in the pipe. The pit for valve group no. 1 was excavated, and highly contaminated earth was found on three sides. Decontamination of the box to a level which permitted visual

examination from a distance disclosed that a section of the pit at floor level had been completely deteriorated by leaking acid solutions.[22] (March 1953)

The largest single source (of discharge to White Oak Creek), which contributed more than 30% of the total, was a leaking group of valves in the north tank farm which served to control the flows of waste from the hot pilot plant. This leak, which began late in 1952, was not located until March of this year. It was found, after extensive excavation through the north tank farm, to be channelling through the ground and entering the retention-pond lines through loose joints in the pipe.[23] (December 1953)

The abnormally high Sr discharge shown the month of February (5 curies versus an average monthly discharge for the last three quarters of 1960 of 2.5 curies) was caused by a release which occurred when drainage in the valve pit of waste monitoring tank W-1 was jetted to the process waste system. A leaking valve bonnet in the pit had contributed an unusual amount of activity to the drainage. It was later determined that another leak, in the line from the pit to the process waste system, permitted the liquid to seep into a storm sewer. The presence of excessive activity in the creek was detected by the monitor located at the 7500 Road bridge. High counts were recorded there on two occassions (over a period of about two or three days), and the timing was such that the pit jettings were definitely ascertained to be the cause. Grab samples were taken from the creek at that time and were added to the monthly composite; the total discharge calculated from the analysis of the composite indicated a release of approximately 26 curies. The discharge at White Oak Dam, however, which is determined from the analysis of a proportional sample, showed a release of only 6 curies for the same period. It is felt that this figure is more nearly correct, and the determination made from the creek sampling is erroneously high due to the method of sampling.[24] (January-March 1961)

In addition to the older occurrences, a more recent incident in the area was reported.

Approximately 200 gallons of raw ILW were inadvertently spilled onto the ground in the North Tank Farm while attempting to jet the contents of W-1A to W-5 on August 29, 1979. An apparent blockage in the transfer line caused the ILW to backflow into an inactive diversion box system and spill onto the ground. The flow into the diversion box was through a line with a valve in the closed position but due to age or some other reason the valve apparently was not properly seated. The plug was caused by bread that was stuffed into the line to create a blockage so that maintenance personnel could purge the line with an inert gas and make a satisfactory weld. The bread normally breaks up as soon as it becomes wet. In this case, more bread than normal was apparently used and the breaking up process took longer than usual. All

contaminated earth was covered with plastic until it was removed on August 31. The plug in the ILW line was removed and successful transfers have since been made through the line.[25] (August 1979)

Site 33 - Oak Ridge Research Reactor 24-Inch Water Line, Building 3085

Although the ORR Reactor is part of planned remedial action under the SFMP, this site is listed for consideration in the LLW leak sites category since the incident described is located away from the building itself.

Surveillance and assistance were provided during excavation and repair of leaks in the 24-inch primary water line of the Oak Ridge Research Reactor. The excavation area extended from #1 pump cell to approximately 80 feet north of Building 3085 to the "Y" pit. Radiation levels were encountered to 2 R/hr and transferable contamination, which resulted from the leaks, was found up to 100 mR/hr. The contamination was primarily ^{115}Cd with traces of ^{24}Na, ^{46}Sc, ^{51}Cr ^{60}Co, ^{95}Zr, ^{137}Cs, and ^{141}Cs. All contaminated soil was transferred to Solid Waste Disposal Area 6. Following repair of the leaks, a six-inch concrete wall was poured on each side of the pipe and covered with 3/8-inch aluminum threadplate.[26] (1975)

Site 34 - Oak Ridge Research Reactor, Building 3042

As in the case of site 33, this area is included for consideration in the LLW leak category to assure that corrective measures, if required, are addressed.

Surveillance and assistance were provided during the excavation of the 11,000 gallon Decay Tank for repair of a leak. The leak had been releasing primary coolant water at a rate of 1.5 gal/min. Radiation levels up to 2 R/hr were encountered along with levels of transferable contamination up to 35 mR/hr at 1 inch. The contamination was effectively confined to the immediate work area. Internal exposures were avoided by the use of plastic suits with a positive air supply. The external exposure was kept well below the permissible limits.[27] (1974)

GROUP 3

Group 3 consists of sites 12 through 20 and site 35. It is the area located south of Central Avenue in the ORNL main complex (see Fig. 1). The buildings used as reference locations for leak sites in this area include:

2531	Radioactive Waste Evaporator Building
3500	Instrumentation and Controls
3503	High Radiation Level Chemical Engineering Lab
3515	
3518	Process Waste Water Treatment Plant
3524	Process Waste System Basin
3525	High Radiation Level Examination Laboratory
3550	Research Laboratory Annex
4505	Unit Operations Laboratory
4507	High Radiation Level Cemical Development Lab.
4508	Metals and Ceramics Laboratory

Site 12 - Leakage East of Building 2531

Building 2531 houses the Radioactive Waste Evaporator used to concentrate the system LLW. The following excerpts point to leakage in the 2531 area.

> The abandoned 2" cast iron waste transfer line was broken at a point east of Building 2531 by the communications construction group during trenching operations. The line was repaired with an Adam's clamp.[28] (April 1978)
>
> The high discharge resulted from an underground crossover that developed between the process waste line from the intermediate-level waste evaporator building and a storm sewer. This leakage allowed some activity to bypass the Waste Treatment Plant.[29] (December 1971)
>
> The high discharge...is still a result of the underground crossover, mentioned in the December 1971 report, that developed between the process waste line from the intermediate-level waste evaporator building and a storm sewer...the high ^{90}Sr discharge from the Waste Evaporator is a carryover from the leak that occurred in December.[30] (January 1972)
>
> As can be noted, the ^{90}Sr discharge to White Oak Lake is still above average. The high discharge reported for January (and possibly part of that for February) was caused by the underground crossover between a process waste line and a storm sewer described in the December 1971 report.[31] (March 1972)

In addition, Witkowski in the 1969 Annual Report on Radioactive Waste Control and Release at the Oak Ridge National Laboratory[2] lists the amount of radioactivity discharged into the Process waste system from the Intermediate-Level Waste Evaporator, Building 2531, as 1.53 curies indicating contamination in this area.

Site 13 - Leakage Underneath Building 3515

This site was included in a tabulation of contaminated areas dated January 31, 1972. The writeup for the site, keyed to engineering drawing No. A-90015-Ø-0063-F Rev(0), stated:

> The area under Building 3515 is contaminated as a result of past use as a radioactive chemical processing plant.

In addition, the following excerpts point to contamination in the Building 3515 area:

> Radioactive material leaking into the condensate line was carried to the concrete drain pipe leading to White Oak Creek. A leaking joint in the concrete pipe about 100 ft south of Building 3515 resulted in spreading contamination to a ditch and surrounding area. The following corrective steps were made:
> a. The contaminated earth in and near the ditch was removed.
> b. Cell floor and pan drains were diverted to W-12 hot waste storage.
> f. The concrete gallery floor, also contaminated as a result of the aforementioned incident, is being decontaminated by chipping. The entire floor was be painted before operation is resumed.[32] (August 1951)

> The pipe trench, which was dug at the southeast corner of the south tank farm, became highly contaminated when a weld in a process tank jacket failed in Building 3515; the water from the jacket was piped to the storm sewer located in this area. This area has been cleaned up by removing the contaminated soil.[32] (August 1951)

Site 14 - Building 3525 Area Contamination to a Sump

This site was included in a tabulation of contaminated areas dated January 31, 1972. The writeup for the site, keyed to engineering drawing A-90015-Ø-0063-F Rev (0), stated the following:

> This is the approximate area where severe contamination may be found resulting from leaking ILW lines discharging water into a ventilation duct which in turn feeds a sump located at this point.

In addition, Witkowski in the 1969 Annual Report on Radioactive Waste Control and Release at the Oak Ridge National Laboratory[2] lists the amount of radioactivity discharged into the Process waste system from Buildings 3525 and 3550 as 0.04 curies indicating contamination in this area.

Site 15 - Area Around and Underneath Building 3550

This site was included in a tabulation of contaminated areas dated January 31, 1972. The writeup for the site, keyed to engineering drawing A-90015-Ø-0063F Rev (0), stated the following:

> Ground beneath the former semi-works ports of 3550 may be contaminated. This building was demolished and all material from the building was moved to the burial ground for disposal.

In addition, Witkowski in the 1969 Annual Report on Radioactive Waste Control and Release at the Oak Ridge National Laboratory[2] lists the sources and amounts of radioactivity discharged into the Process waste system from Buildings 3525 and 3550 as 0.04 curies indicating contamination in this area.

Site 16 - 3500 Block Sanitary Sewer Contamination

Contamination of the 3500 Block area of the sanitary sewer system (See Fig. 3) has resulted from inleakage of various LLW sources, such as Building 3026 and other radioisotope areas. In addition, Sites 16, 17 and 18 appear to be interrelated. Excerpts from Operations Division Reports such as the following, document the contamination.

> ...Unusually high activity in White Oak Creek, caused by the effluent from the sewage disposal plant, led to the discovery of a broken weld in the "hot" waste line between the Radioisotope Area and the tank farm. The leak was found to be in Central Avenue in front of Building 3026 where the sewer line and the "hot" waste line run parallel within several feet of each other. The active solution was seeping into the sewer through loose joints in the pipe. The leak has been repaired and precautions taken to prevent recurrences of this nature in the future.[33] (July-September 1958)

> Sampling and monitor placements in various tributaries of the sewage system indicate that this leakage is occurring at or near the lift station in the section of sewer line on Central Avenue that was modified about 1972 because of inleakage of radioactive waste. The leak has been patched and does not appear to be leaking now. However, this is considered to be a temporary measure and permanent repairs will be made when we are positive that this is the leak.[34] (April 1978)

> ...A relatively high amount (31.3 mCi) was released from the Sanitary system. This system was sampled in sections and some inleakage was found throughout. The bulk of the contamination; however, appears to have originated from the Fourth Street Section and the area southeast of Building 3500.[35] (April 1980)

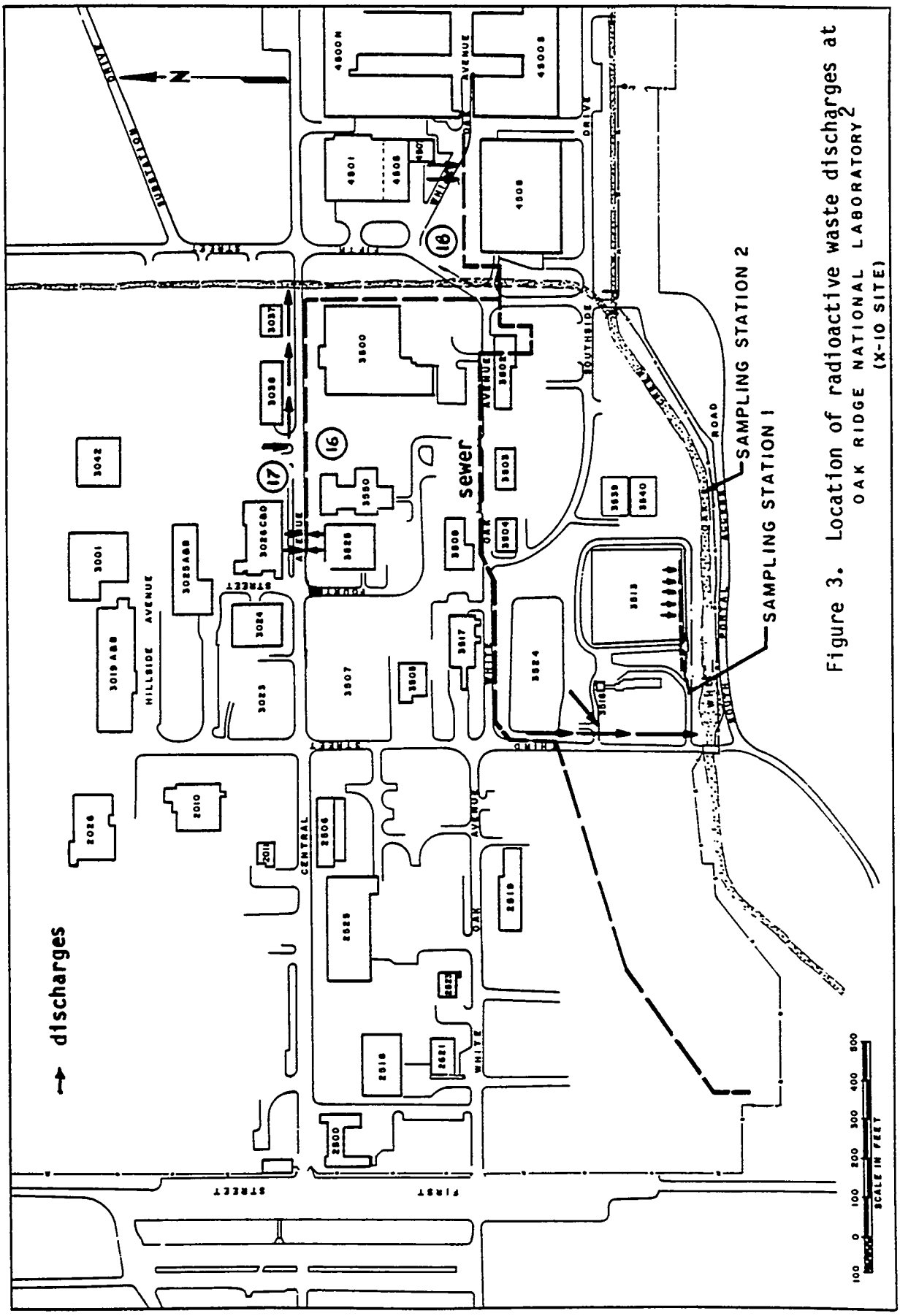

Figure 3. Location of radioactive waste discharges at[2]

> The activity in the storm sewer discharge seeped into an abandoned section of clay pipe from contaminated soil around the process waste equalization basin. The activity in the sanitary sewer came mainly from inleakage under Central Avenue in front of Building 3026, although some traces of activity have also been found in the sewer running east to west on the north side of Building 4508. The leak into the sewer in front of Building 3026 was undoubtedly from earth contaminated by an old intermediate-level waste line that leaked and was taken out of service years ago.[2] (1969)

> The leak into the Fifth Street branch of the creek is still being investigated. The most recent sampling data obtained indicate that the activity is seeping into a storm sewer running north to south between the Radioisotope and the 3039 Stack areas. This sewer joins the Central Avenue sewer that runs east to the Fifth Street branch of the creek. The activity appears to be seeping into the storm sewer from the soil around waste tank WC-2; this soil was contaminated at one time by a leak from a broken sampler line from that tank.[2] (1969)

Site 17 - Abandoned Line Central Avenue Area

This site was included in a tabulation of contaminated areas dated January 31, 1972 and keyed to engineering drawing A-90015-Ø-0063F Rev (0). Contamination is also suspected based on the following reference.

> The activity in the storm sewer discharge seeped into an abandoned section of clay pipe from contaminated soil around the process equalization basin. The activity in the sanitary sewer came mainly from in-leakage under Central Avenue in front of Building 3026, although some traces of activity have also been found in the sewer running east to west on the north side of Building 4508. The leak into the sewer in front of Building 3026 was undoubtedly from earth contaminated by an old intermediate-level waste line that leaked and was taken out of service years ago.[2] (1969)

Site 18 - ^{90}Sr Contamination North of Building 4508

This site was included in a tabulation of contaminated areas dated January 31, 1972 and keyed to engineering drawing A-90015-Ø-0063F Rev.(0). The writeup for the site stated the following:

> Ground contaminated by ^{90}Sr, north of Building 4508. An unsuccessful attempt was made in 1970 to determine the source of this contamination.

This area has since been paved.

Site 19 - Spill Between Building 3518 and Third Street

The spill in this area was described as follows:

ORNL-DWG 86-7180

SITE NO.

21 LAGOON ROAD AND MELTON VALLEY DRIVE
22 MELTON VALLEY DRIVE AND SWSA-5 ACCESS ROAD
23 7500 AREA
24 WEST OF MELTON VALLEY PUMPING STATION
25 BLDG 7920/MELTON VALLEY PUMPING STATION AREA
26 BLDG 7920 DITCH LINE
27 HYDROFRACTURE NO. 1 – RELEASE OF GROUT
28 PIT 6 – SOUTHEAST
29 END OF TRENCH 7 ACCESS ROAD
30 GAGING STATION NORTHWEST OF BLDG 7852
31 BLDG 7852 – HYDROFRACTURE INJECTION AREA (SOUTH)
32 MELTON VALLEY TRANSFER LINE

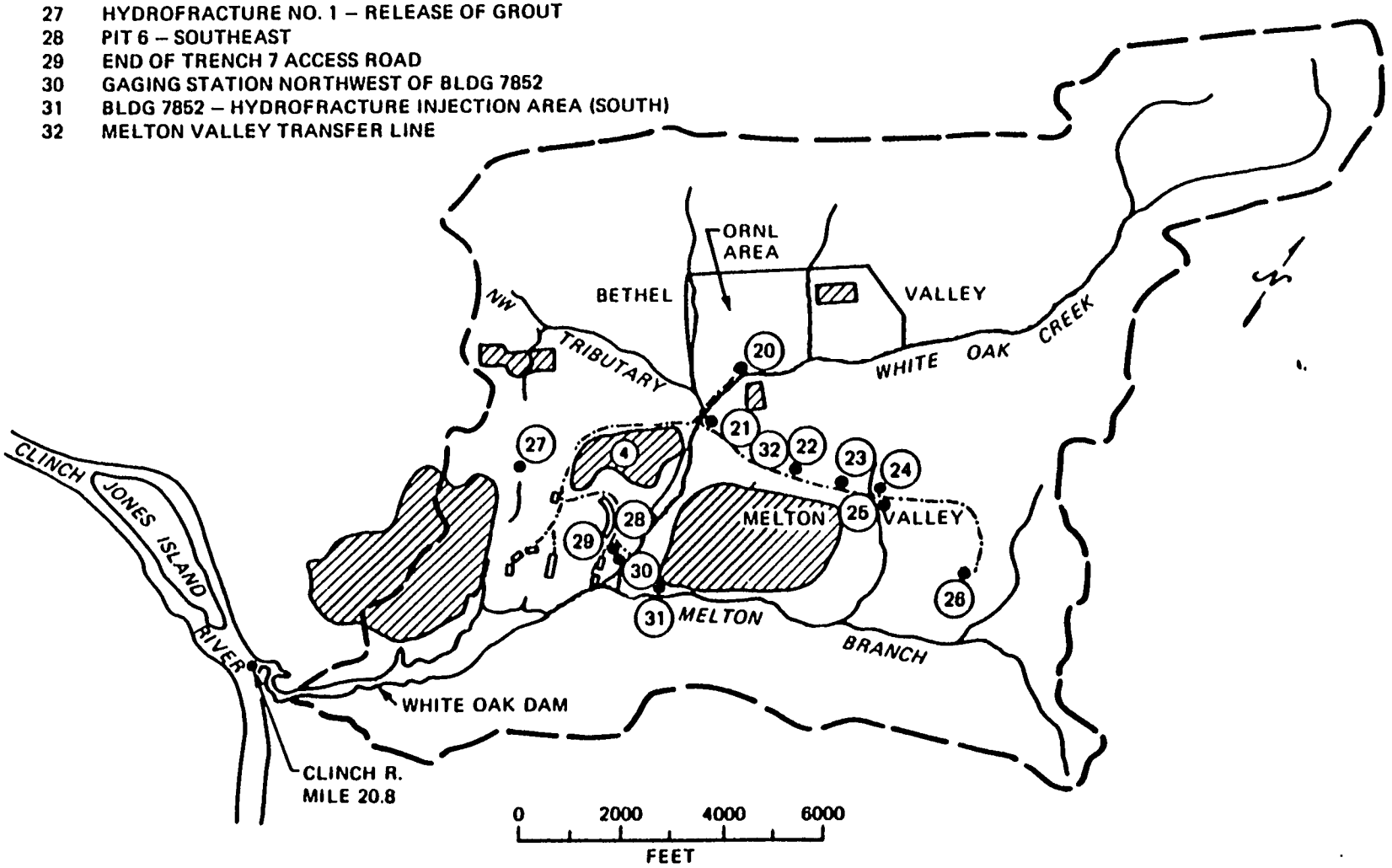

Figure 4. Location of LLW Leak Sites in Melton Valley.

> A radioactive spill of less than 100 gallons (estimated) was discovered on May 5, 1978, along Third Street opposite the Equalization Basin (Site 3524). The material was concentrated strip solution from the Process Waste Treatment Plant which was contaminated with low level amounts of ^{90}Sr and ^{137}Cs. About 6 cubic yards of contaminated dirt was removed for burial. The line was punctured by an air hammer bit during the installation of a waste transfer line from Building 1504.[36] (May 1978)

Site 20 - Break In Transfer Line NW of SWSA-1

This site was included in a tabulation of contaminated areas dated January 31, 1972 and keyed to engineering drawing A-90015-Ø-0063F Rev (0). The writeup for the site stated the following:

> (A) break (which occurred) in the ILW transfer line northwest of BG #1 (SWSA-1) permitted leakage into White Oak Creek.

Site 35 - Solvent Column Pilot Plant, Building 3503.

The following excerpts describe the incident at this site.

> Much of the activity was the result of a series of operating accidents at the Solvent Column Pilot Plant Building. One of the accidents was the leaking of a discharge line from a waste tank. The other was a spill at the thorium waste tank which overflowed and contaminated the surrounding ground and groundwater. The groundwater surrounding these tanks is pumped to the settling basin.[37] (December 1954)

> ...Some of the activity contributed was the result of an operating accident in the Solvent Column Pilot Plant, Building 3503..."[38] (November 1954)

GROUP 4

Group 4 consists of sites 21 through 26 and site 32 (See Fig. 4). The group is located along the Melton Valley Drive LLW transfer line and includes the line itself. The buildings in this area used as reference locations for the leak sites include:

7500	Nuclear Safety Pilot Plant
7505	Nuclear Safety Pilot Plant Storage
7567	Intermediate Level Waste Pumping Station
7920	Transuranium Processing Plant

Figures 5 and 6 show the pipeline system in this area.

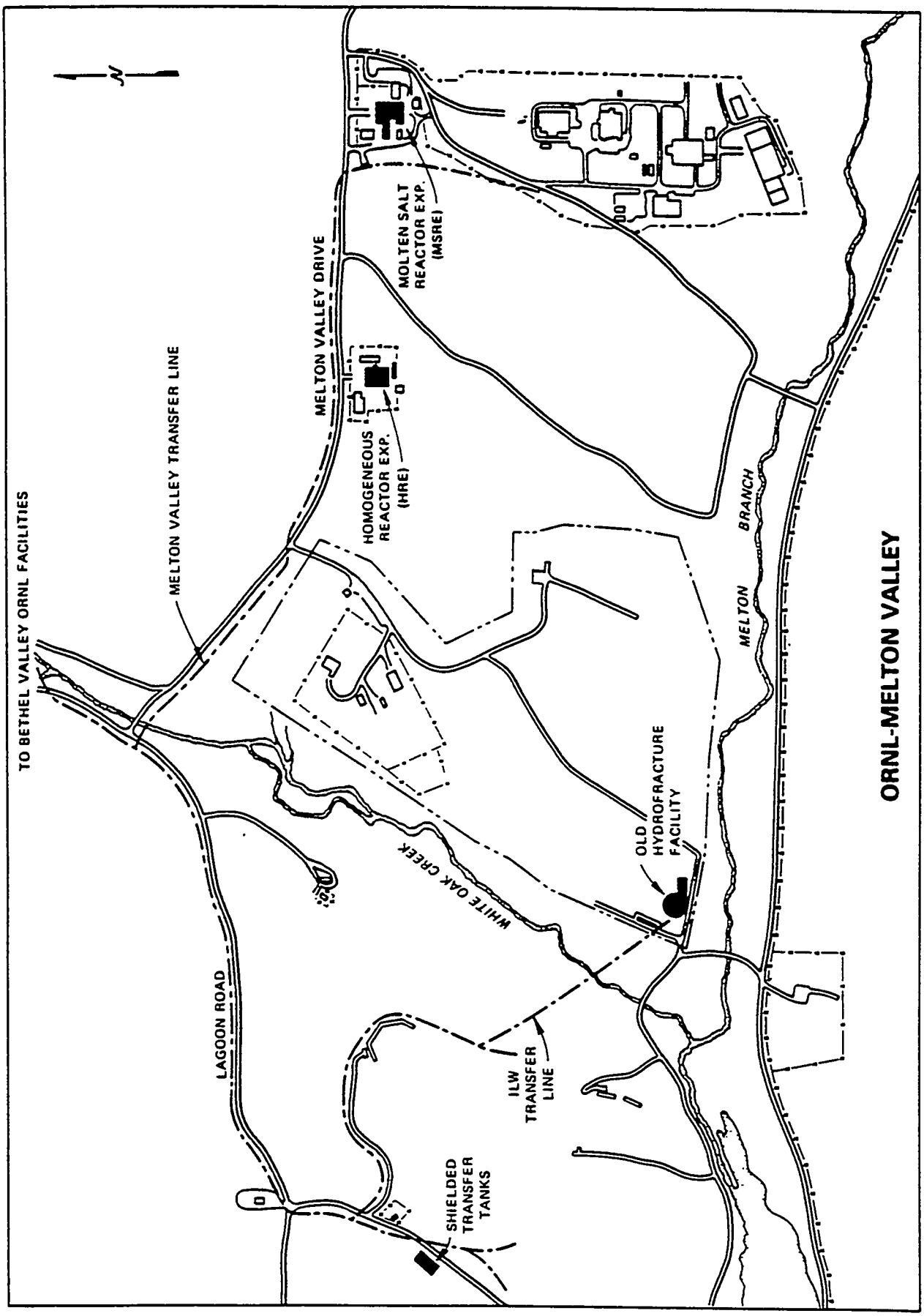

Figure 5. LLW (ILW) and Melton Valley Transfer Lines

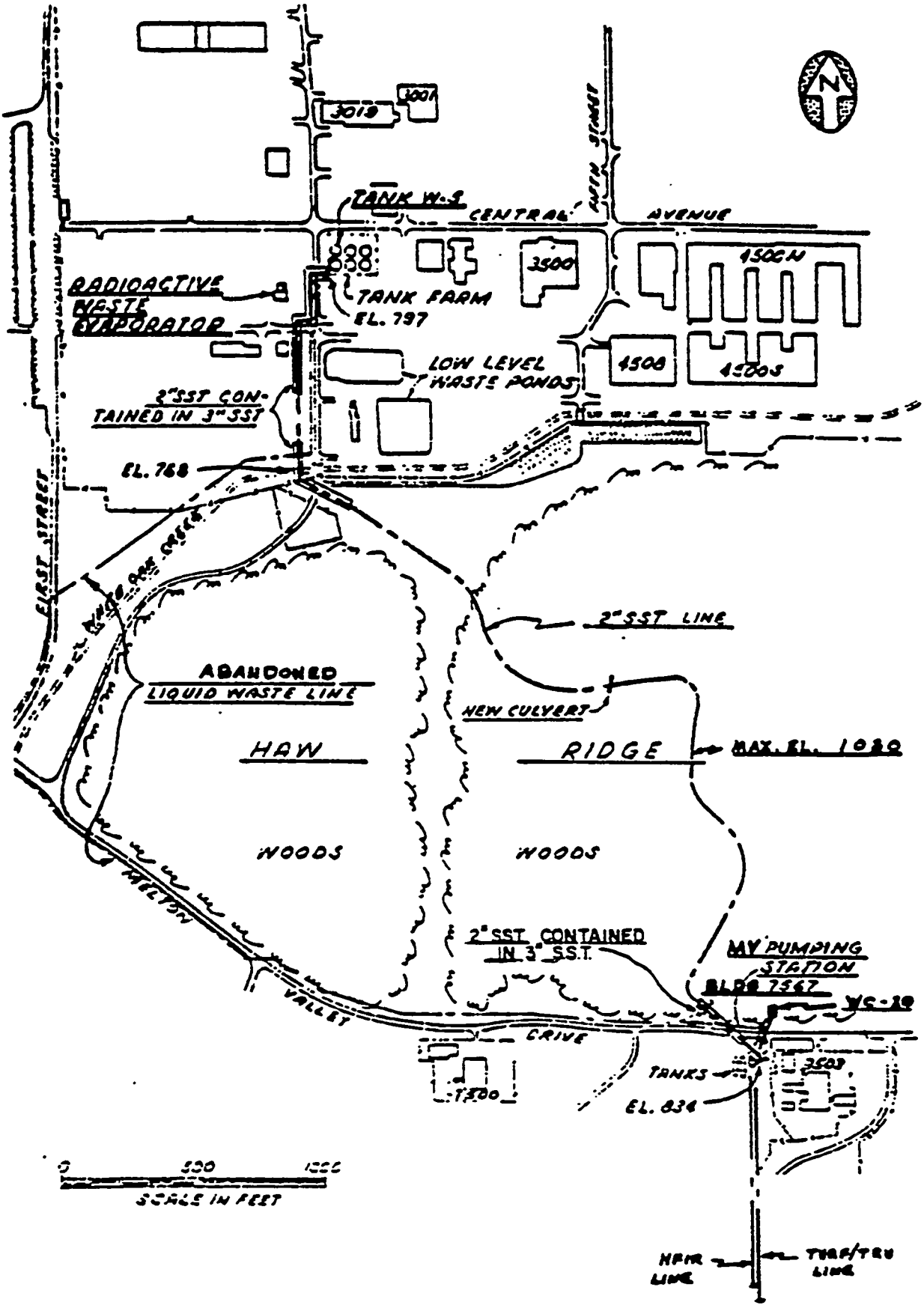

Figure 6. Transfer Line from Melton Valley Pumping Station.[18]

Site 21 - Break In Transfer Line at Lagoon Road and Melton Valley Drive Intersection

The leak in this area was described as follows:

> ...and the other (break in transfer line to the pit), located where the line crosses the creek near the bridge to the 7500 area, was due to damage by heavy equipment. Although neither incident resulted in a serious hazard, the second (this one) could have seriously contaminated the creek if it had occurred at a time when a waste transfer was being made...An inspection of the line at the creek, while repairs were being made, indicated that there may be other potential leaks in the line.[39] (April-June 1960)

Site 22 - Leak In Transfer Line near Melton Valley Drive and SWSA-5 Access Road Intersection

The leak in this area was described as follows:

> Two leaks occurred in the transfer lines in Melton Valley, one on July 9 (1970) and the other on July 31. The first leak was in the line between the Melton Valley pumping station and the south tank farm at the entrance to Burial Ground 5...Both failures occurred at mechanical,neoprene-gasketed, pipe joints.
>
> The contamination in both locations was removed so that there was no significant release of activity into the creek. The main section of pipe, (where this leak occurred), was repaired, pressure tested, and returned to service.[40] (July 1970)

Site 23 - Melton Valley Transfer Line Leak North of 7500 Area

The leak in this area was described as follows:

> A 2100-gallon spill occurred when a coupling in the waste transfer line from Melton Valley to the tank farm failed between the MSRE (Building 7505) and the NSPP (Building 7500). The resultant contamination, ^{244}Cm plus a mixture of fission products, was cleaned up in about two weeks. The amount of radioactivity released into the Clinch River from the spill was not significant.[41] (July 1969)

Also in this area, but not a transfer of LLW line leak, is an area included in a tabulation of contaminated areas dated January 31, 1972. The writeup for the site stated the following:

> The purge water from the hot storage pool in Bldg. 7500 was discharged to the ground and flowed along natural drinage east of Building 7500.

Site 24 - Leak West of Melton Valley Pumping Station

> On January 15, 1971, while liquid waste was being transferred from Melton Valley to the Tank Farm, a leak developed during the transfer operation and an area about 100 sq ft west of the pumping station was contaminated. The area was subsequently excavated. There was no spread of contamination outside the immediate area and no contamination of personnel nor exposures beyond normal working limits.[42] (January 1971)

Site 25 - Leak Between Building 7920 and Melton Valley Pumping Station

> ...The second leak (see site 22 for first leak) occurred in the line (on July 31, 1970) between the Transuranium Processing Plant (Building 7920) and the Melton Valley pumping station. Both failures occurred at mechanical, neoprene-gasketed, pipe joints.
>
> The contamination in both locations was removed so that there was no significant release of activity into creek. The line from the Transuranium Processing Plant could not pass the pressure test after the repairs were made and was removed from service. It is now being replaced, on an emergency basis, with a new line.[43] (July 1980)

Site 26 - Building 7920 Ditch Line Contamination

This site was included in a tabulation of contaminated areas dated January 31, 1972 and keyed to engineering drawing A-90015-Ø-063F Rev (0). The writeup for the site stated the following:

> A leak in the ILW line from Building 7920 contaminated the ditch line along the high flux isotope reactor access road. The liquid from this leakage crossed under the road through the culverts and flowed along the natural drainage parallel to Melton Branch Circle in a southerly direction.

Site 32 - Melton Valley Transfer Line

The original Melton Valley transfer line was a flanged and gasketed carbon steel pipeline which intersected the LLW transfer line at Lagoon Road and Melton Valley Drive. As shown in Fig. 2, the old pipeline ran parallel to Melton Valley Drive to the Melton Valley pumping station and then extended south to the TRU and HFIR facilities. Several leak sites have been reported along the line during its operational history as described in Group 4 of this report. A new line connecting the Melton Valley Pumping Station to the evaporater service tanks was installed in 1973. This line replaces an earlier cast iron line and is a 2-inch stainless steel line with a cathodic protection system. A description of transfer line modifications in this area can be found in Binford and Orfi.[18]

GROUP 5

Group 5 consists of sites 27 through 31 and is the area located in the Burial Ground Area in Melton Valley. The buildings used as reference locations uor the leak sites include:

7852	Shale Fracturing Batch Plant
7810	LLW Seepage Trench 6
7818	LLW Seepage Trench 7

Site 27 - Hydrofracture No. 1 - Release of Grout

The following excerpts reveal contamination in this area.

> ...The 0.72 curie of strontium measured at monitoring station No. 4 in Melton Branch, which accounts for 70% of the total strontium released to the lake, came from a drilling of an observation well at the Shale Fracturing site. The activity was washed out of the well when the drill cut through the layers of grout from the Shale Fracturing ILW waste disposal operation.[44] (June 1968)
>
> Significant, in terms of river MPC (Maximum Permissible Concentration), are the strotium releases from Bethel Valley (0.17 curies) and Melton Valley (1.35 curie). The strotium from Melton Valley is attributed to a contaminated seep from an uncapped observation well at the Shale Fracture Area.[45] (July 1968)

Site 28 and 30

Sites 28 and 30 were included in the Intermediate Level Waste Transfer Line Decommissioning Project completed in 1983.[46] The history of these two sites is included here in an effort to provide background information in addressing the need for additional remedial action.

Background. Sites where leakage of the ILW line between X-10 and the Hydrofracture Facility had occurred were originally identified by a reconnaissance survey of the pipeline route conducted by the Environmental Sciences Division at ORNL (Duguid and Sealand, August 12, 1975)[47] in July of 1973. A second survey of the pipeline was conducted by the Industrial Safety and Applied Health Physics Division (ISAHP) at ORNL in February 1979[48] after the ILW line had been removed from service. Based on the findings of these surveys, these two leak sites were entombed as described by Walls et al,[46] A summary of the site description, surveys, characterization efforts, and entombment follows for both Sites 28 and 30.

Site 28 Summary - Leak in LLW Transfer Line SE of Trench 6. Site 28 (also referred to as Leak Site 1) is located approximately 150 feet south of LLW Trench 6 (ORNL coordinates N18,363-E27,976). (See Fig. 7) The site slopes to the southwest dropping 15 feet over a distance of 100 feet. The leak was first surveyed in July of 1973 but had occurred at an earlier date and had been repaired. Repair had required limited

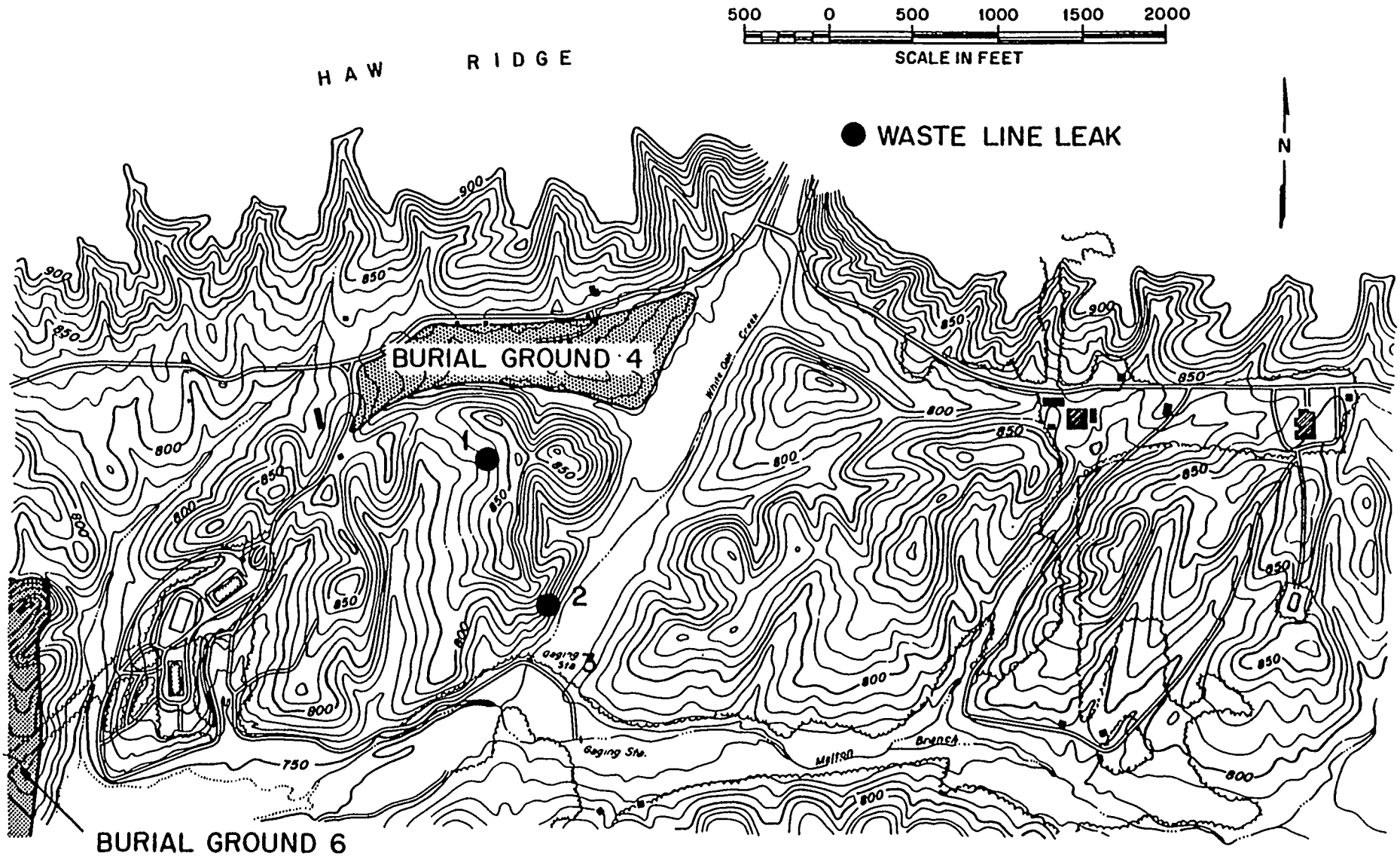

Figure 7. Contour Map Showing Location of Waste Line Leaks.[46]

excavation which had been filled by uncontaminated dirt. The contamination was concentrated in a small area near the leak where it had reached the ground surface and spread laterally for several feet. Survey and soil sample analysis indicated radionuclide downslope movement to the southwest. Beta-gamma rates measured at 3 feet above ground surface ranged from 240 mR/hr to 1 R/hr. (See Fig. 8) Soil sample analysis revealed significant mixed fission product contamination with concentrations ranging from 0.01 to approximately 50 Ci/g of beta-gamma activity and gross alpha activities up to 1 nCi/g. The beta-gamma activity was attributed primarily to ^{137}Cs and ^{90}Sr. The primary alpha contributor was attributed to ^{244}Cm, with minor concentrations of ^{241}Am, ^{238}Pu, and ^{239}Pu. No groundwater monitoring wells were drilled at this site since nearby Trench 6, located nearby, was a known source of groundwater contamination.

Site 30 Summary - Leak in LLW Transfer Line NW of Building 7852. Site 30 (also referred to as Leak Site 2) is located on the transfer line approximately 200 feet west of White Oak Creek (ORNL coordinates N17,680-E28,000). At this location surface and groundwater drainage is in an easterly direction toward White Oak Creek. The site drops 15 feet over a distance of 100 feet. The waste had seeped from a pipe coupling and had reached ground surface where it had spread laterally over a small area. During the 1973 survey, contaminated sediment was observed all the way to the creek. Soil samples ranged from 2 Ci/g to 600 Ci/g of beta-gamma activity with a maximum total alpha concentration of 3.7 Ci/g. See Fig. 9 for site survey results. The major contributors to the waste were believed to be the same as site 28. Three groundwater monitoring wells were installed to determine the effect of the leak on groundwater radioactivity levels. After concluding that the leak was contributing to groundwater contamination, over 3000 cubic feet of contaminated soil was removed and disposed. Later groundwater monitoring showed markedly decreased levels of radionuclide concentrations.

The second survey of the area conducted by ISAPH showed elevated readings at this site, suggesting that either additional leakage had occurred or that there had been inadequate removal of the contaminated soil. At 3 feet above the ground surface, beta-gamma activity ranged from 240 mR/hr to 800 mR/hr along the line.

Entombment of Sites 28 and 30. The entombment efforts are described by Walls et al.[46] The primary objective was to restrict surface water movement through the leak areas. To accomplish this, two impermeable barriers were constructed over each site: a bentonite clay cap and an asphaltic- concrete pavement cover. See Figs. 10 and 11 for site plans. After removal of the ILW piping in the area and clearance of the sites and their surrounding areas of vegetation (which resulted in the removal of 100 cubic yards of vegetation and contaminated soil), and herbicide application, clean clay fill was placed over the sites. Next, bentonite clay was mixed with the fill. Earth fill was applied over the bentonite clay cap and contoured, a crusted stone base of 6-inches was applied, and 1.5-inches of asphaltic concrete was applied

ORNL–DWG 81-11566R

LEAK SITE NO. 1

SURVEY NO.	mR/h
1	240
2	240
3	860
4	260
5	580
6	400
7	600
8	400
9	400
10	620
11	1000
12	420
13	410

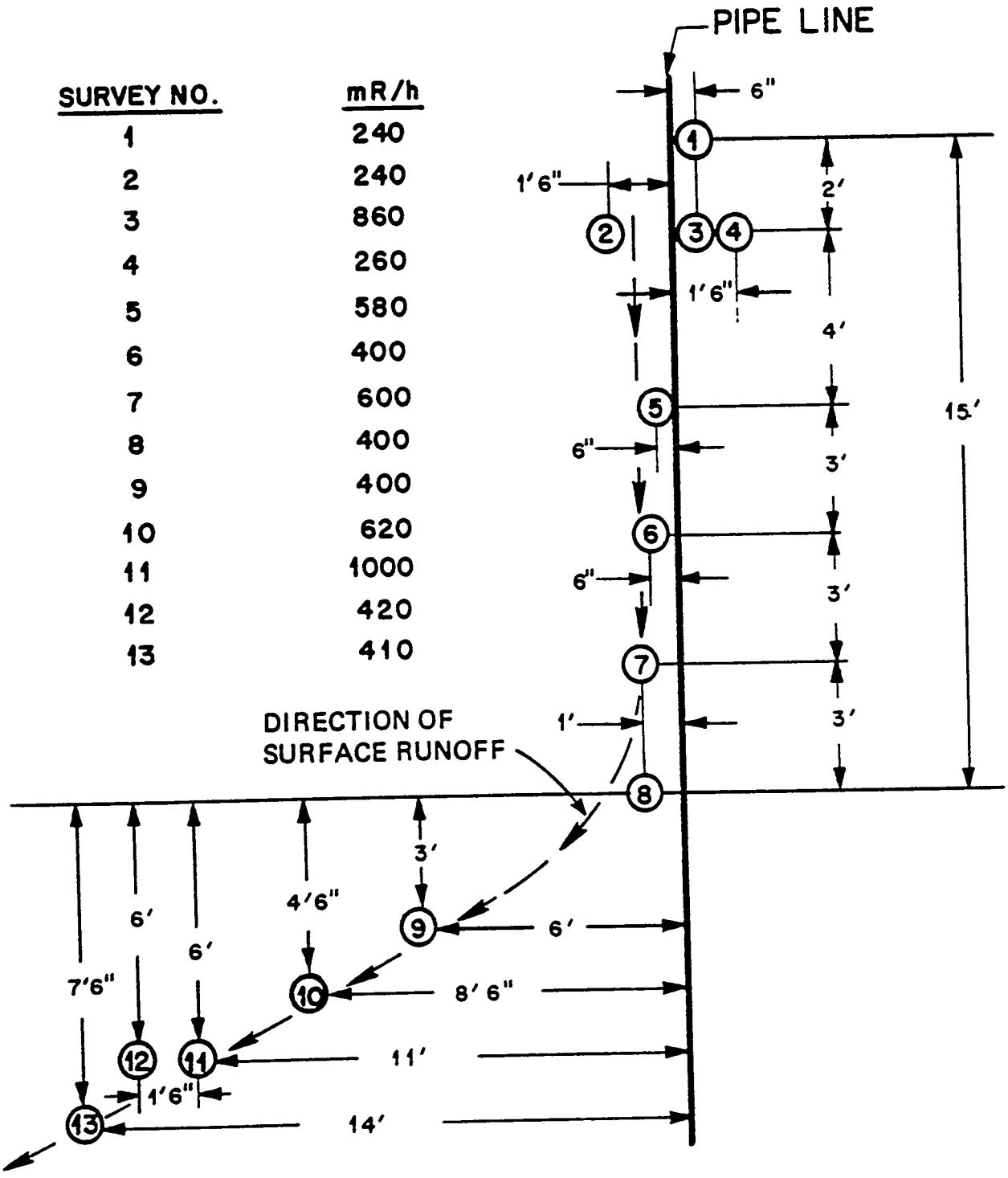

Figure 8. Beta-gamma survey results at Leak Site No. 1 (Site 28)

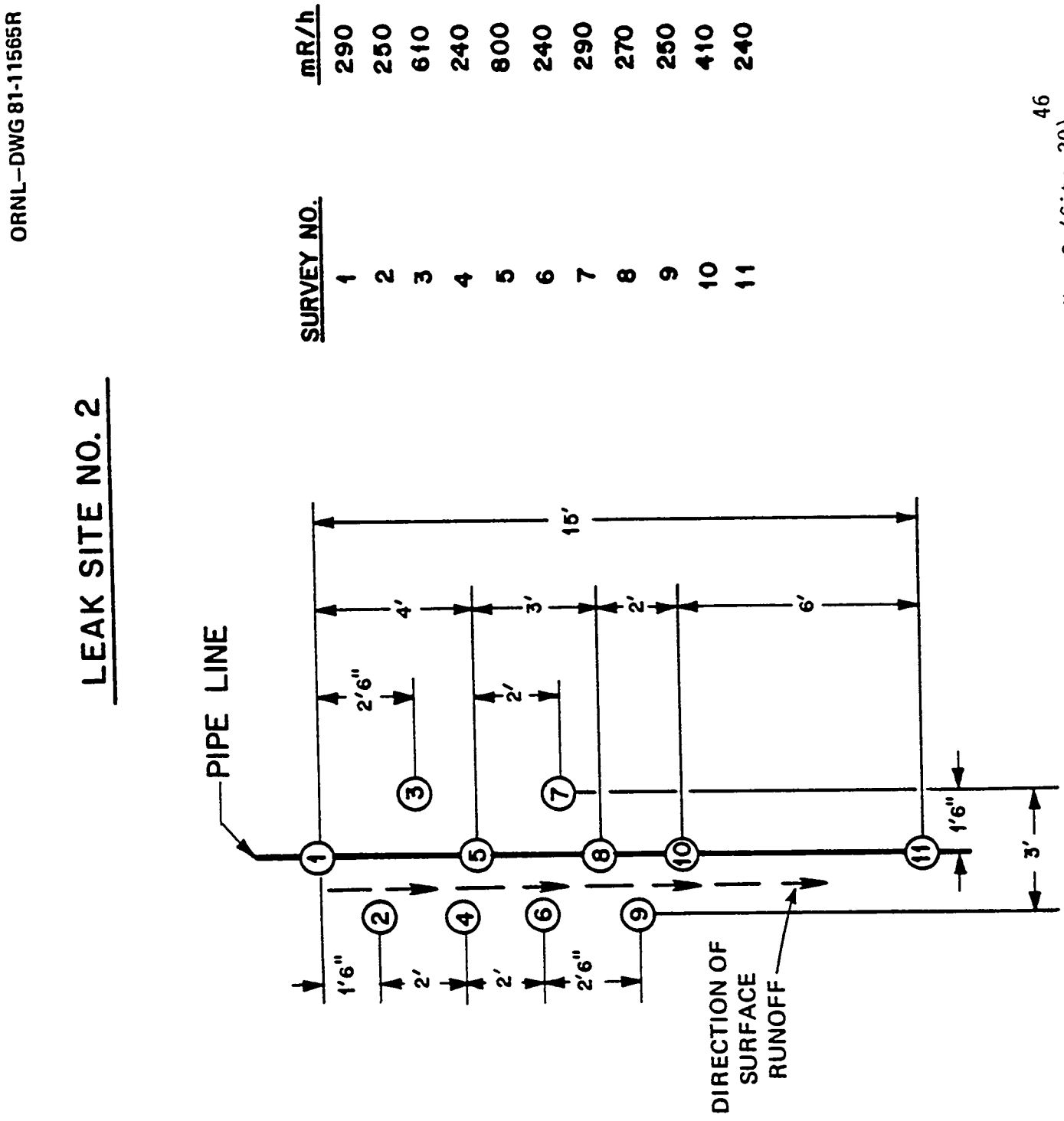

Figure 9. Beta-gamma survey results at Leak Site No. 2 (Site 30)[46]

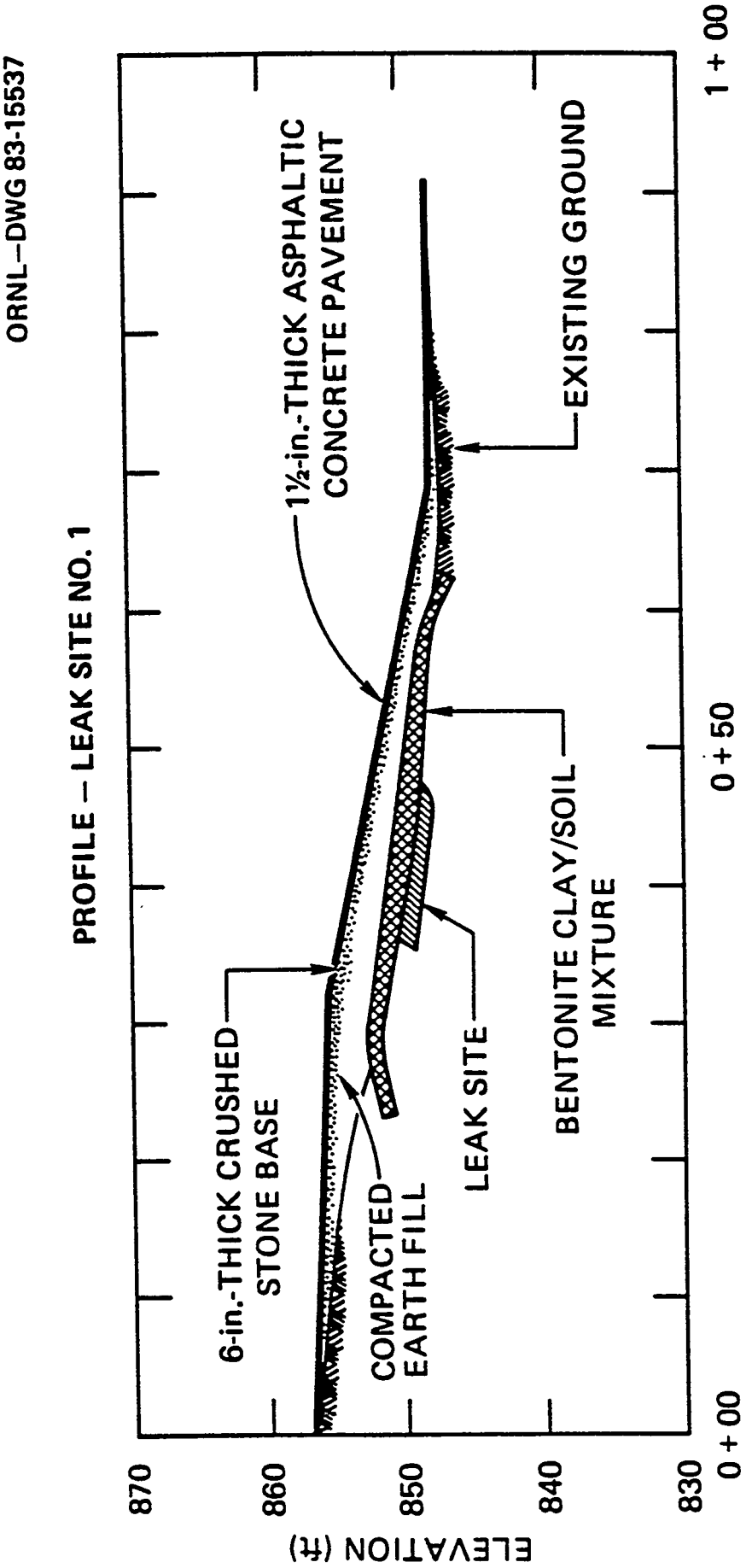

Figure 10. Site plan for Leak Site No. 1 (Site 28)[46]

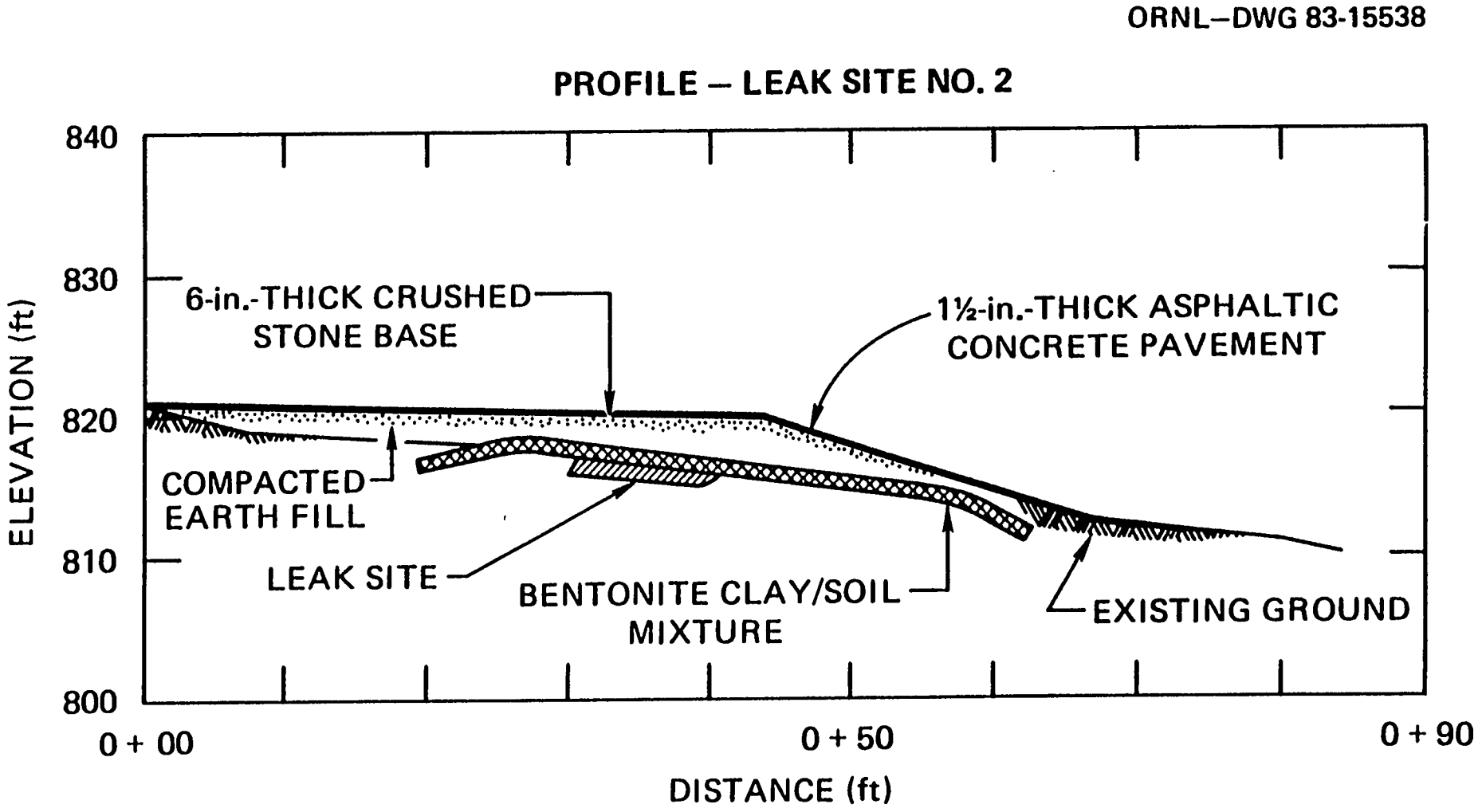

Figure 11. Site plan for Leak Site No. 2 (Site 30)

and sealed. The leak areas were fenced, rip-rapped around the asphalt base with gravel, and the remaining disturbed areas were seeded and stabilized. Figures 12 and 13 show final site conditions.

Post-Monitoring. Gamma exposure rates over the entombed structures and in the immediate surrounding areas were within background range for the sites (0.1-1 mR/hr). Several isolated areas exhibiting gamma exposure rates from 5 mR/hr to 100 mR/hr were located in the vicinity of the leak sites, presumably associated with contaminated soil and vegetation from previous operations. Decontamination was not attempted due to the isolated nature of the radioactivity and the remote site location.

Site 29 - Spill at end of Trench 7 Access Road

This spill is described in the following excerpt:

> Near the end of the waste transfer to the trenches, a section of plastic pipeline ruptured and approximately 3000 gallons of waste were spilled in an area just north of Trench 7. The total activity was estimated at 100 curies, consisting mainly of cesium and cerium and about 10 curies of strontium. The contamination was covered with approximately five feet of soil and the area was contoured to prevent leaching by surface water. None of the contamination was permitted to reach the creek.[49] (April 1966)

Site 31 - Building 7852 Hydrofracture Injection Area Spillage

This incident was described as follows:

> On June 30, 1977, at approximately 3:30 pm a valve at the Shale Fracture Facility failed when the waste slurry was being pumped at 130 gpm to a depth of 820 feet at 3200 psi. An estimated 2300 gallons of waste slurry leaked into the "waste pit" which is designed to handle such events. The injection was terminated. A by-pass was installed around the faulty valve, and well and associated pipe system were flushed with water thereby placing the facility in stand-by condition. All of the valves in the high pressure system were reinspected and cores, seats, and seals were replaced...The contents of the waste pit were included in the injection which contained 82,000 gallons...The injection was completed on July 2, 1977.[50] (June 1977)

ORNL-PHOTO 4708-83

Figure 12. Final site conditions at Leak Site No. 1 (Site 28) [46]

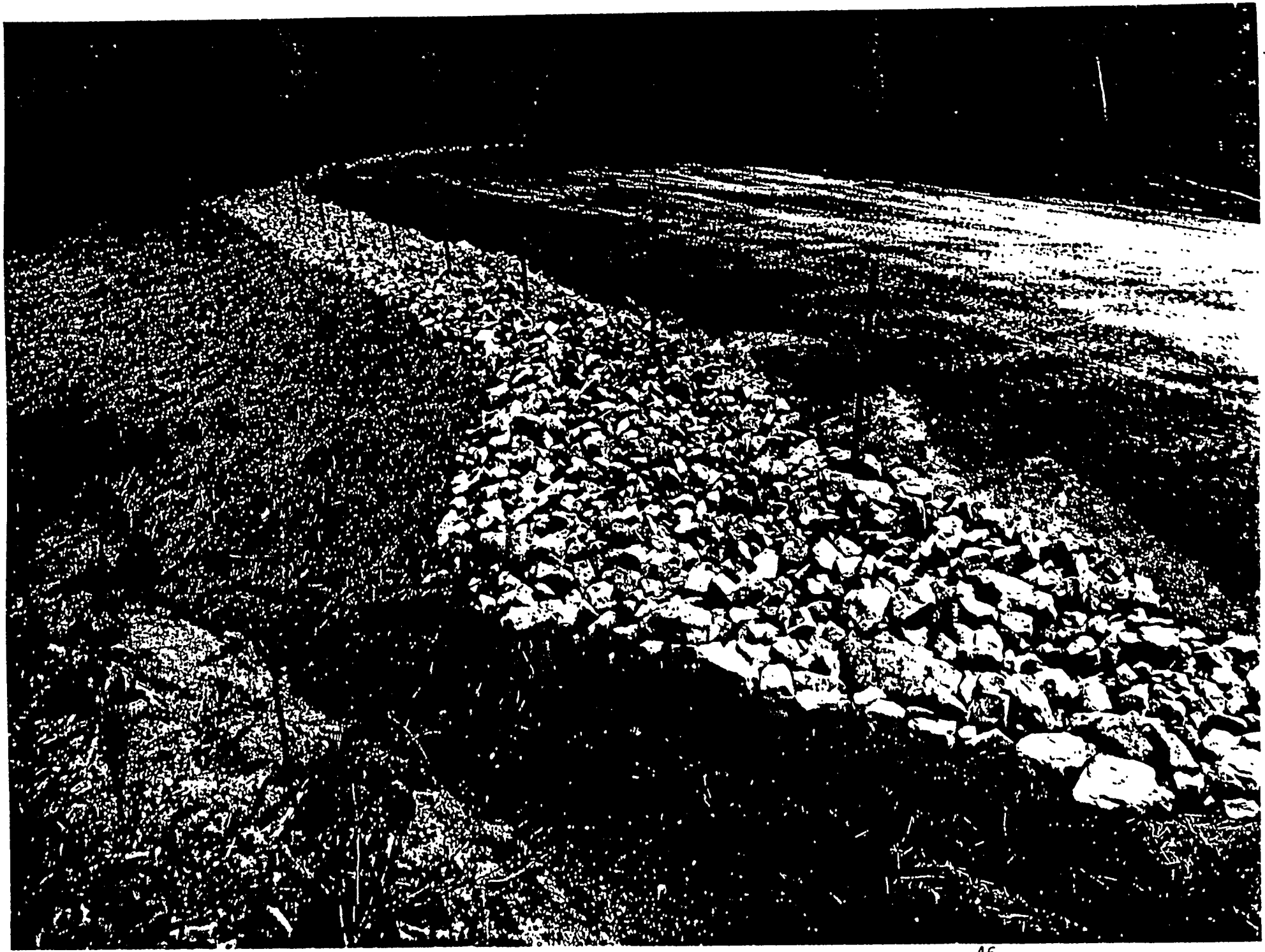

Figure 13. Final site conditions at Leak Site No. 2 (Site 30)

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APPENDIX A.1

Intra-Laboratory Correspondence Documenting Contamination in the General Isotopes Area

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

To: E. Lamb

Date: March 25, 1964

Cc: R. W. Schaich ✓

From: C. L. Ottinger

Subject: FPDL ^{137}Cs Discharges

CY-1963
3 7o

The ^{137}Cs discharge from the FPDL, based on radiochemical analysis of individual batches, was 30,000 curies. There was no other known release of ^{137}Cs. One item in question is the fate of the ~50,000 curies that was released from the ^{137}Cs-glass melting operations. Cold and tracer tests on this system indicated that most of this ^{137}Cs should have been absorbed in the furnace; however, there is no direct evidence of this as yet. It is possible that most of this ^{137}Cs was removed by the in-cell scrubbing solution, which solution was at that time discharged to waste without sampling. If this occurred ~80,000 curies of the observed 100,000 curies would be accounted for. In any event, since no ^{137}Cs-glass work is planned, the area to be considered in reducing ^{137}Cs discharge would be the ^{137}Cs mainstream process.

Nearly all of the ^{137}Cs waste solutions are saturated ammonium alum (at 10°C) and are not readily adaptable to chemical processing. A proposal has been submitted (Memo: CLO to EEB dated 9-13-63, copy attached) for a revision of existing equipment to provide a third crystallizer. Such a system should reduce the ^{137}Cs waste losses by at least 75%. The cost of this installation was estimated at $8,500 and no significant increase in operating costs would result. While there are other treatment systems that might be considered, installation of this relatively inexpensive item would go a long way toward reducing a bad problem.

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

March 15, 1967

To: J. H. Gillette

Subject: Isotope Area Process Wastes

For the last several years we have suspected that a considerable portion of the total activity carried in the process waste system has been seeping into the reactor process waste line where the line passes through the Isotope Area. In order to determine the volume of the seep and the amount of activity it contains, a temporary bypass around the Isotope Area was installed for the reactor waste to isolate the leaking section and to make activity and flow measurements (see attached sketch). The results obtained during the four week period in February were as follows:

Average seep flow	-	12,000 gal/day
Maximum seep flow	-	24,000 gal/day
Minimum seep flow	-	2,000 gal/day
Total strontium in seep (4 week period)	-	0.47 curie

The 0.47 curie of strontium that seeped into the line is approximately one-half of total normally discharged into the process waste system (based on measurements made in last six months of 1966). Routine beta analyses of the total reactor waste and seep stream, taken over the last two years, indicate no trend downward. It makes one wonder if the activity is coming exclusively from contaminated soil or from current releases through a leaking ILW waste line.

The total discharge of activity into the process waste system has been relatively high since the waste evaporator operation was started last spring. In the near future we hope to correct the problems at the evaporator and to practically eliminate the discharge from that operation. When this is accomplished and the activity carried in the process waste system returns to a normal level, the only significant discharges into the system will come from the Isotope Area in the seep into the reactor waste line and from the Isotope Area normal discharges. I would conservatively guess that the Isotope Area will then account for more than 75% of all of the activity.

I am presenting this information to you, hoping that your people may have some ideas on how to improve the situation. We'll be glad to work with them on the problem at any time.

EJW

E. J. Witkowski

EJW:hg

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

March 26, 1971

To: J. H. Gillette

Subject: Investigation of Leak into Process Waste Line Under Building 3047

Reference: Reports dated 9-27-70, 10-29-70, 11-19-70, 12-7-70, 2-1-71 and 3-2-71

Analytical results listed in the report dated 2-1-71 were not complete. The completed analytical results are listed on page 2.

A perforated casing 8 in. in diameter was installed in the excavation on the north side of Bldg. 3047 that is described in the 2-1-71 report. The casing forms well 3047N-2 and is located adjacent to the process waste line (east side) and 80 in. from the Bldg. 3047 wall and extends approximately 6 in. below the process waste line.

Two wells have been installed in the floor of Room 110 in Bldg. 3047. Well 110w is 11 ft from the north wall and 14 in. from the west wall. Well 110s is located 45 in. from the south wall and 74 in. from the east wall.

Well 110w is 100 in. deep to solid rock. The bottom 26 in. is compacted gravel and the top portion is compacted clay. Water stands approximately 5 in. deep in the bottom of the well. The water was pumped out of the well and the flow into the well was 6 liters/min or 95 gal/hr. A 9-liter sample of the water has been submitted for complete analysis. No radiation was detected with a survey meter. Samples of contaminated gravel read 5 mR/hr wet and 8 mR/hr dry and were placed in Room 210 for experiments by A. F. Rupp. Preliminary results from the 9-liter sample from well 110w are listed below:

	d/m/ml					c/m/ml		
Sample No.	^{137}Cs*	^{60}Co*	^{106}Ru*	^{90}Sr	^{89}Sr	GB	Gα	TRE
110 w-11 (unfiltered)	12.5	0.67	16.8	4850	Not detected	970	None	555
110 w-11 (filtered)	1.15	0.79	8.57	2850	Not detected	790	None	340

*Estimates only – high beta

UCN-430

Sample No.	^{137}Cs d/m/ml	^{60}Co d/m/ml	^{106}Ru d/m/ml	^{65}Zn d/m/ml	^{90}Sr d/m/ml	^{144}Ce Gross Alpha d/m/ml	c/m/ml	Gross β c/m/ml	TRE c/m/ml
MH 112-11 (unfiltered)	0.3	1.7	8.5	3.4	5.7	0.89	<0.05	6.3	2.6
MH 112-11 (filtered)					5.6	0.08	<0.05	4.4	1.9
MH 233-11 (unfiltered)	0.12	0.8	5.8	1.3	59.7	0.16	<0.05	32.4	15.4
MH 233-11 (filtered)					69.5	0.07	<0.05	35.6	16.4
MH 114-11 (unfiltered)	7.1	0.9	8.5	2.4	117	0.49	<0.05	87.7	41.8
MH 114-11 (filtered)					147	0.05	<0.05	73.6	39.0
Well 3047 N-1-11 (unfiltered)	$\leq 1 \times 10^{-2}$	≤0.15	$\leq 1 \times 10^{-2}$	$\leq 2.5 \times 10^{-2}$	68.4	<0.01	<0.05	31.8	22.0
Well 3047 N-1-11 (filtered)					68.5	<0.01	<0.05	32.8	21.4

J. H. Gillette

March 26, 1971

Well 110s is approximately 90% complete. Contaminated rock and gravel (2 mR/hr) were encountered at a depth of 96 in. Solid rock was found at 105 in. depth and slopes from north to south at about a 30° angle. Approximately 2 in. of water stands in the south portion of the hole. Water was removed from the bottom of the hole via a vacuum flask intermittently during a 20-min period. The seepage into the hole is approximately 1 gal/hr. A 1-liter sample has been submitted to Analytical Chemistry for analysis.

The pH measurements of the water in the four wells were made on 3-26-71, and the results are listed below:

Well 3047 N-1	4.7 rechecked
Well 3047 N-2	6.5
Well 110w	7
Well 110s	6

E. E. Pierce

E. E. Pierce

EEP:lk

cc: E. E. Beauchamp
T. A. Butler
A. F. Rupp
H. T. Russell
R. W. Schaich
J. A. Setaro
R. D. Seagren

A-1-6

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

May 18, 1971

To: J. H. Gillette

Subject: Investigation of Underground Leakage Into Process Waste Line

Reference: Letter to J. H. Gillette, Dated April 23, 1971, Entitled Leak from Sanitary Sewer System to Process Waste System East of Bldg. 3047

Fifty millicuries of sodium-24 was added to the sanitary sewer system via MH-12 north of Bldg. 3047 on May 4, 1971. No increase in radioactivity was detected in the process waste line (MH-114). This indicates little or no leaking from the sanitary sewer to the process drain in this area under normal conditions.

Water was added to well 110W in Bldg. 3047 for eight hours (8:00 p.m., 5/4/71 to 4:00 a.m., 5/5/71) at a rate of approximately 700 gal/hr. The flow and radiation monitors in MH-114 were checked each hour. There was no significant increase in either the flow or the radioactivity.

Fifty millicuries of sodium-24 was added to well 110W in Bldg. 3047 at 10:30 a.m. on May 6, 1971, and followed with 1400 gal of water. No increase in flow or radioactivity levels was detected in MH-114.

Water was added to well 3047N-1 for eight hours at a rate of 800 gal/hr (8:00 p.m., 5/6/71 to 4:00 a.m., 5/7/71). No increase in flow or radioactivity was detected in MH-114. Rain began at 3:00 a.m. and an increase in flow in MH-114 was recorded at 4:00 a.m.

Seven samples (1-liter volume) were taken during a recent period of heavy rain in an effort to determine the effect of increased underground water flow on the process waste line in the vicinity of Bldg. 3047 (see attached sketch A-RD-2663). E. I. Wyatt mentioned that F. L. Culler was interested in the tritium contamination of waste discharged into White Oak Creek. Four of the samples were analyzed for tritium. The sample results are listed below:

J. H. Gillette

May 18, 1971

Sample No.	Date	Time	Gross β (d/m/ml)	^{137}Cs	Tritium, ±20% (d/m/ml)	^{90}Sr (d/m/ml)
Well 110W	5/13/71	12:00 N	3400	strong	<15	3640
Well 3047N-1	"	12:10 PM	10	-		
Well 3047N-2	"	12:20 PM	80	-		
MH-112	"	12:30 PM	10	-	<15	
MH-233	"	12:40 PM	100	-		
MH-233A*	"	12:40 PM	300	-	250	
MH-114	"	12:45 PM	200	moderate	500	

*Sample #MH-233A was obtained from water flowing into MH-233 through the abandoned line shown on sketch A-RD-2663.

The flow through MH-114 was 3780 gal/hr at 12:00 noon and 3540 gal/hr at 1:00 p.m.

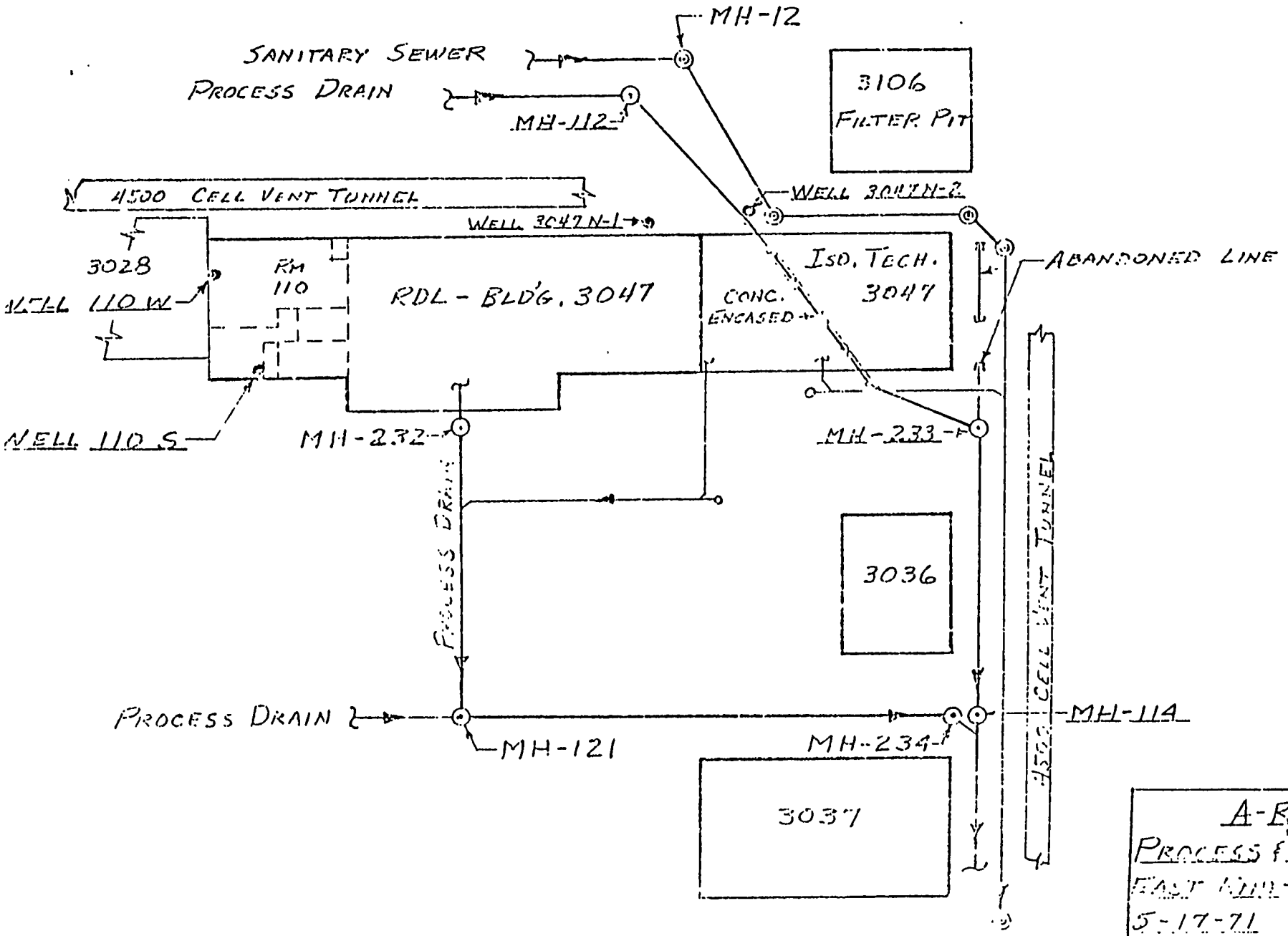
Radicactivity levels were 350 c/m/ml at 12:00 noon and 375 c/m/ml at 1:00 p.m.

E. E. Pierce

EEP:ds

Attachment

cc: E. E. Beauchamp
T. A. Butler
F. E. Harrington
E. Lamb
A. F. Rupp
H. T. Russell
R. W. Schaich
J. A. Setaro



A-RD-2663

PROCESS & SANITARY DR

EAST ARK. - TEXAS

5-17-71

SCALE - 1/4" = 10'

A.1-8

APPENDIX B

Intra-laboratory Correspondence Summarizing Group 1 Dry Weather Dye Tracing Activities

October 7, 1985

[redacted] Building 3047, ORNL

Summary of Dry-Weather Dye Tracing Activities

This letter report on the dry-weather dye tracing activities associated with the LLW transfer line leak near Buildings 3074 and 3019 completes Milestone V.F.1.C.1 of the Environmental Restoration and Facilities Upgrade Program. This is actually an update and summary of work that was completed and reported in a letter to D. E. Ferguson, dated July 19, 1985, and in a presentation made to Mike Mobley of the Tennessee Department of Health and Environment on August 8, 1985. Copies of the letter and word slides used in the briefing are attached, along with a summary of the key findings of the work, which I have prepared for this report.

Dale D. Huff

Dale D. Huff, Building 1505, MS-002 (4-7859)

DDH:jsw

Attachment

cc: N. H. Cutshall, Building 1505, MS-003
L. E. Stratton, Building 3504, MS-002
File - DDH

DRY-WEATHER DYE TRACING INVESTIGATION - GROUNDWATER FLOW PATHWAYS FROM LINE BREAK

Introduction

In February 1985, the appearance of Sr-90 at elevated concentrations in White Oak Creek and at the ORNL Sewage Treatment Plan, resulted in identification of a LLW transfer line break at a point, between Buildings 3074 and 3019 in the main ORNL complex. Initial testing at that time showed movement of radionuclides into sanitary sewer lines on the west and south sides of Building 3019 and into a sanitary sewer line to the east of Building 3001 (see Figure 1). Dye testing at that time also showed water movement to the east along geologic strike to a sump at the ORR Building (3042). The broken line was taken out of service, and the lines leading toward and away from the break were packed off and sealed with a grout plug. At the point of the break, there was an extensive cavity in the underlying limestone that extended at least 7 feet below the line elevation. A view of the break is shown in Figure 2 (ORNL photograph No. 1989-85). Since there was interest in identifying migration pathways away from the break, a riser pipe with diffuser holes at its base (see Figure 3, ORNL photograph No. 1987-85) was placed in the cavity and backfill material was placed around it such that it provided a port for later injection of dye or tracer for studies of groundwater movement. Two tests were planned: one for dry weather conditions, which is described here, and another to be completed in wet-weather with elevated water-table conditions.

Methods

On June 17, 1985, charcoal packets were placed in the 39 locations shown in Figures 1, 4, and 5. The packets absorb dye present in water flowing past the sites and can be retrieved and analyzed by extraction methods to determine a relative measure of quantity of dye passing each site. At each location, a two-day exposure to background conditions was allowed, and the packets were removed and analyzed. New packets were put in place, and on June 19, 1985, a 1000 gm quantity of Fluorescein dye was dissolved and injected into the cavity via the riser pipe that had been installed previously. (The injection site is shown in Figure 1.) This was followed with an unmeasured quantity of water that was allowed to flow via a hose placed in the riser pipe for about 4 hours. It is estimated that the volume was of the order of 1000 gallons. Charcoal packets were removed on June 21, 24, 26, 28 and July 1 and 3, 1985. Each time a packet was removed, it was rplaced with a fresh one (except on July 3 when the test was ended). The packets were analyzed using an

alcohol-KOH extraction procedure and spectrophotometry. The sensitivity of the method was of the order of a nanogram of dye present on a packet, and background ranged between 10 and 30 nanograms in most cases. Positive presence of dye was defined as a value that exceeded 5 times the pre-injection background.

Results

The sampling sites where dye was detected are shown in Figures 6 and 7. The size of the circle around each location is proportional to the quantity of dye observed at the site over the interval when sampling was in progress. There was no adjustment made for background, flow rate, or even time of exposure, so the results must be viewed as only semi-quantitative and indicative of relative magnitude of dye passing the location. In some cases, packets were lost or sites were not visited, and these gaps will affect the results in the sense that the values are indicative of the lower limit of dye present at a site.

Discussion

Reference to Figures 6 and 7 reveals that the most dominant pathway for dye movement was from the leak site to Building 3042 (ORR). Figures 8 and 9 show the temporal pattern of dye retention by packets at the sump in the ORR building. Figure 8 represents groundwater that is collected from pipes through the sump walls and has no opportunity to mix with process water associated with reactor operations. The similar graph in Figure 9 represents a mixture of groundwater from outside the building and process water from floor drains inside the ORR building. It is evident that the dye has entered in the groundwater from outside the building. The collection level for that groundwater is at approximately 800 feet msl elevation. The injection point for the dye was approximately 820 feet msl, so there is a definite hydraulic gradient towards the sump of about 20 feet over a distance of about 450 feet. It is important to note that dye exits the inner sump via a storm drain that leads to Fifth Creek in the vicinity of Building 3047, and is pumped into the process sewer system from the outer sump. Thus the presence of dye in the storm drains and creek outside Building 3042 must originate from the sump. Similarly, the presence of dye in the process waste lines to the southeast of Building 3042 also is explained by its presence in ;he sump. Actually, there ae several other sumps in the vicinity of the ORR (see Figure 10), and it is likely that one or more of these sumps contribute to the storm drain that is north and east of the ORR building.

A secondary pathway for dye migration also exists. The presence of dye in the sanitary sewer line to the south and east of Building 3019 indicates that there is a connecting pathway from the leak site around or under Building 3019. It is believed that this pathway is associated with the permeable backfill used in trenches that carry sewer lines and/or transfer lines and possibly with migration along the 3019 building foundation. Since the Sr-90 contamination that prompted the study was evident only during very high water table conditions, it is possible this pathway was activated by the introduction of excess water following dye injection. Subsequent testing should employ only the concentrated dye solution, and not use a follow-up flushing.

Another possibly noteworthy observation is that there was an apparent secondary increase of dye during the period from June 29 through July 1, 1985. This appeared in the pattern at all sites and was verified by reanalyzing samples for all dates at individual sites, so any day-to-day instrumental differences were eliminated. There was a heavy rainfall 6 hours prior to collection of the samples on July 1, which is the most likely explanation for the increases observed.

Conclusions

Based upon the results obtained, the following conclusions are suggested.

1. There is a strong component of flow from the site of the transfer line break to the ORR sump. The flow direction is along strike, which suggests flow is controlled in the limestone units of the Chickamauga Formation by joints and solution openings. Further, the groundwater table elevation control (depression) associated with the ORR sump produces a strong gradient toward the sump and probably controls local groundwater flow. Monitoring of all sumps is warranted in subsequent tracer tests, and radionuclide monitoring should be initiated if it is not done at present.

2. The appearance of dye in the sanitary sewer line to the south and east of Building 3019 strongly suggests that flow in more permeable waste transfer lines can be an important flow pathway, and warrant further investigation and development of control measures.

3. To further examine the flow system, a wet-weather dye test should be conducted, and in the intervening time, additional monitoring points, particularly shallow piezometers and sumps should be identified.

4. Based upon studies in First Creek, there is no evidence that a migration pathway exists to the west from the line break site. It is likely a groundwater divide is located to the west of Building 3019, and that flow does not occur in that direction, with the possible exception of flow along the building foundation or in shallow backfilled trenches adjacent to the west end of Building 3019.

DRY-WEATHER TRACING INVESTIGATION

Figures

1. Location of line break and sites in sanitary sewer for charcoal packets used to detect dye during test.

2. Photograph of excavation at line break site, showing cavity below the deteriorated line.

3. Diffuser pipe that was placed into cavity before backfilling. Other items are packers used in grouting lines that were taken out of service.

4. Locations of dye-detection sites in the process waste system.

5. Locations of dye-detection sites in storm drains and creeks.

6. Sites where dye was found in the process sewer system. Circle size is proportional to amount detected.

7. Sites where dye was found in the sanitary sewers, creek, and storm drains. Circles are proportional to the amount detected.

8. Amount of dye found at the ORR sump during each test period (inner sump).

9. Amount of dye in outer (process waste) sump at ORR during each test interval.

10. Locations and bottom elevations of sumps used for groundwater control near the ORR.

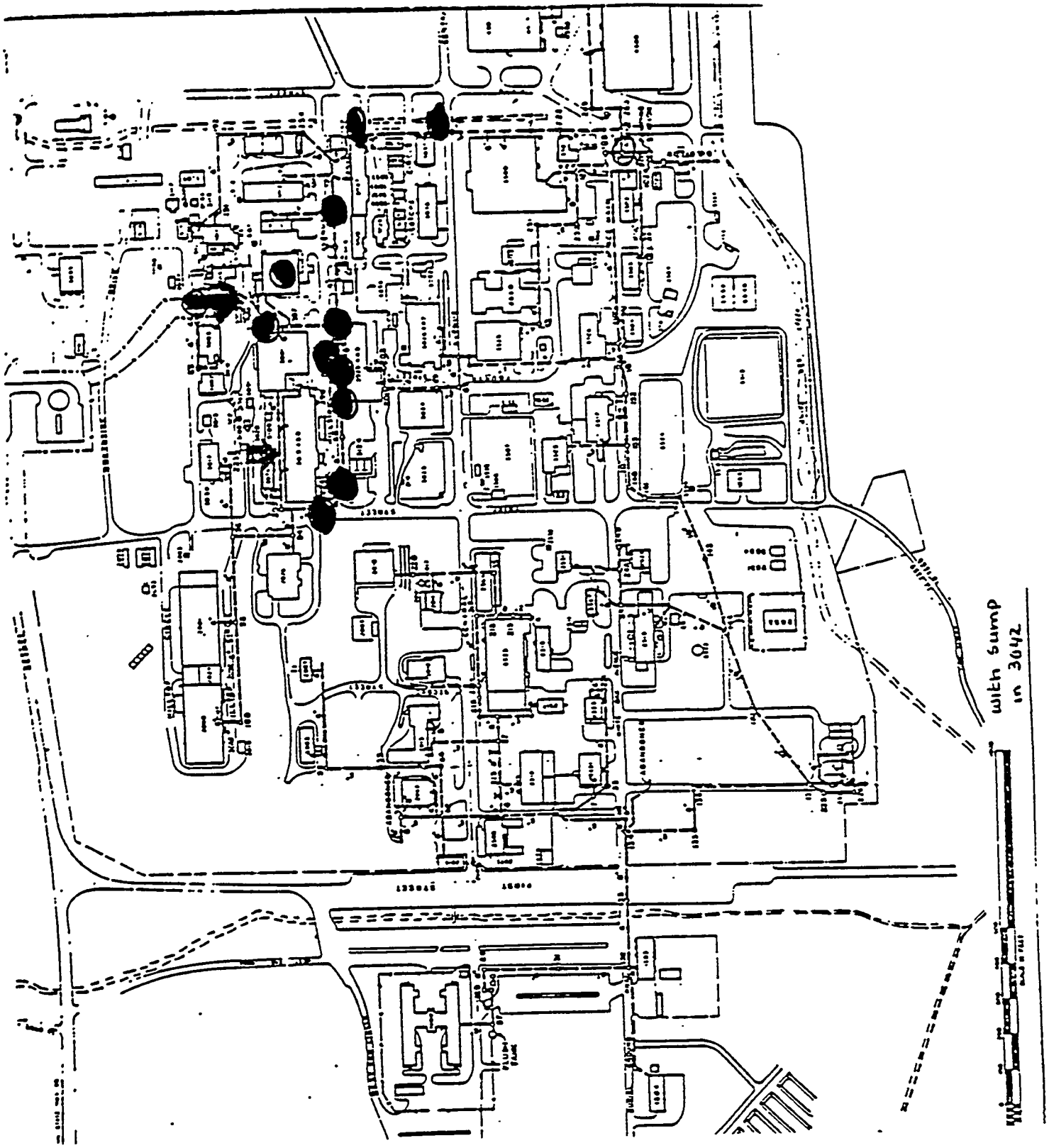


Figure 1. Planning Map
Oak Ridge National Laboratory
Bethel Valley
Sanitary Sewer System

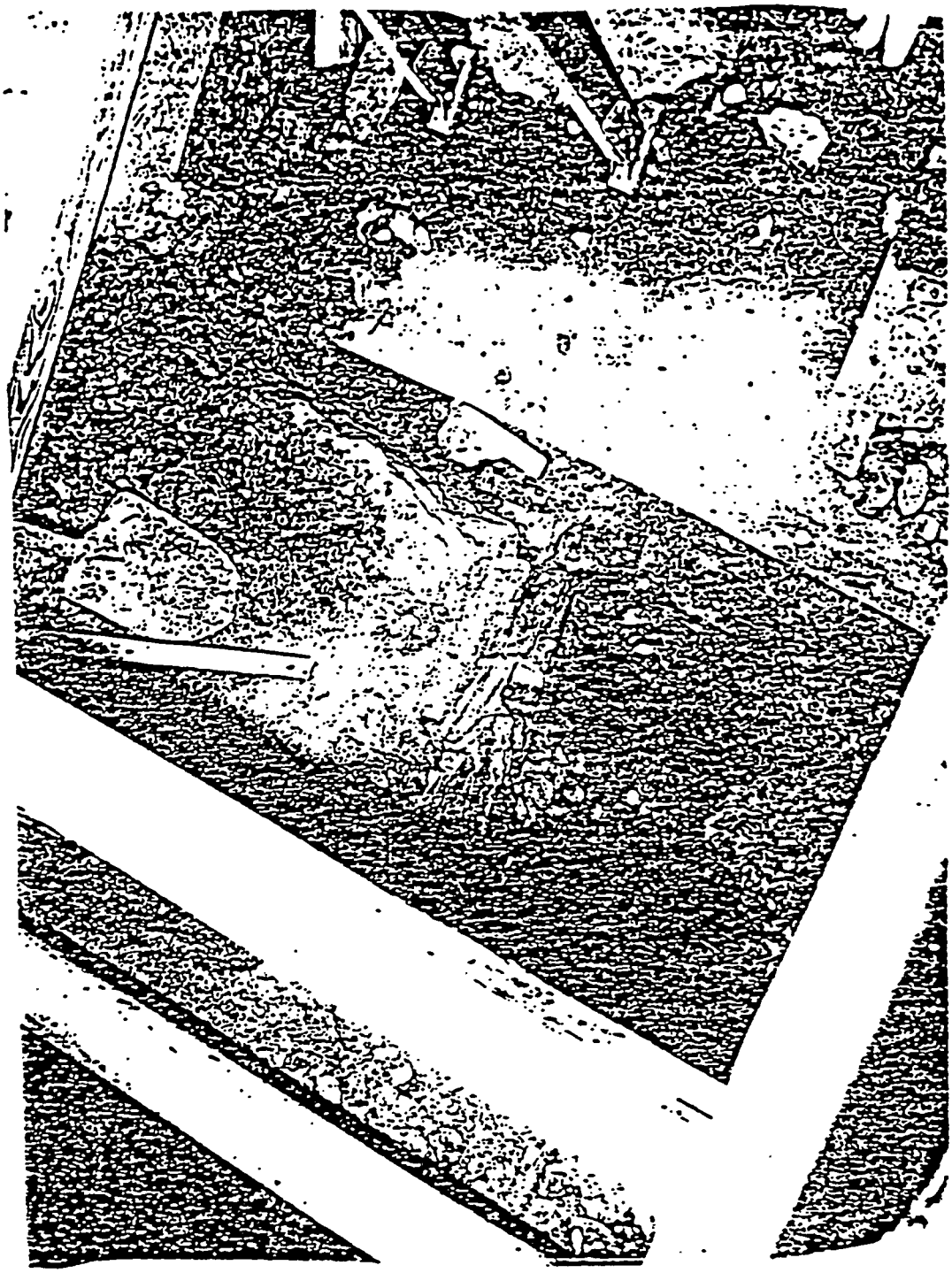


Figure 2. Line Break and Cavity

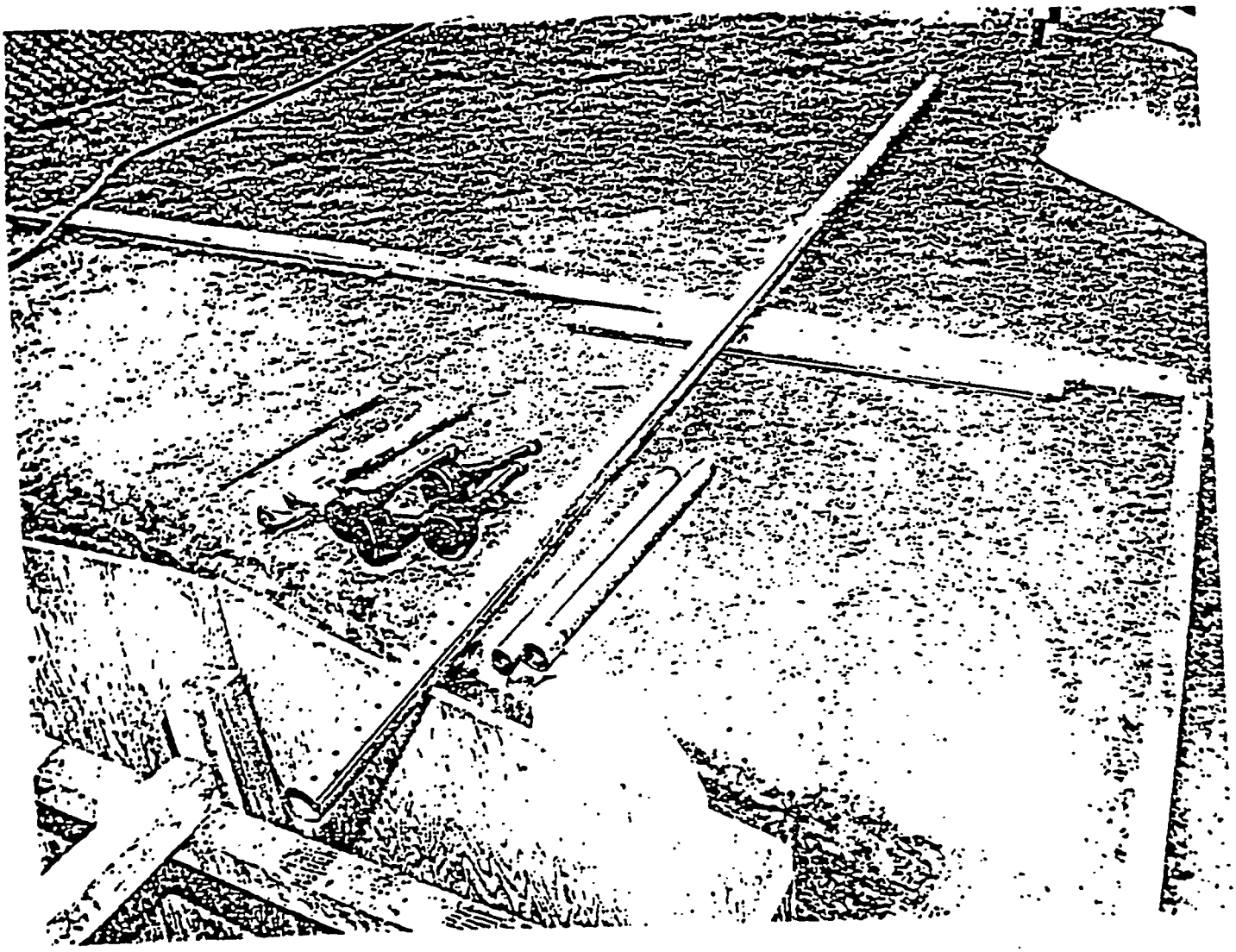


Figure 3. Diffuser and Riser Pipe
For Dye Injection

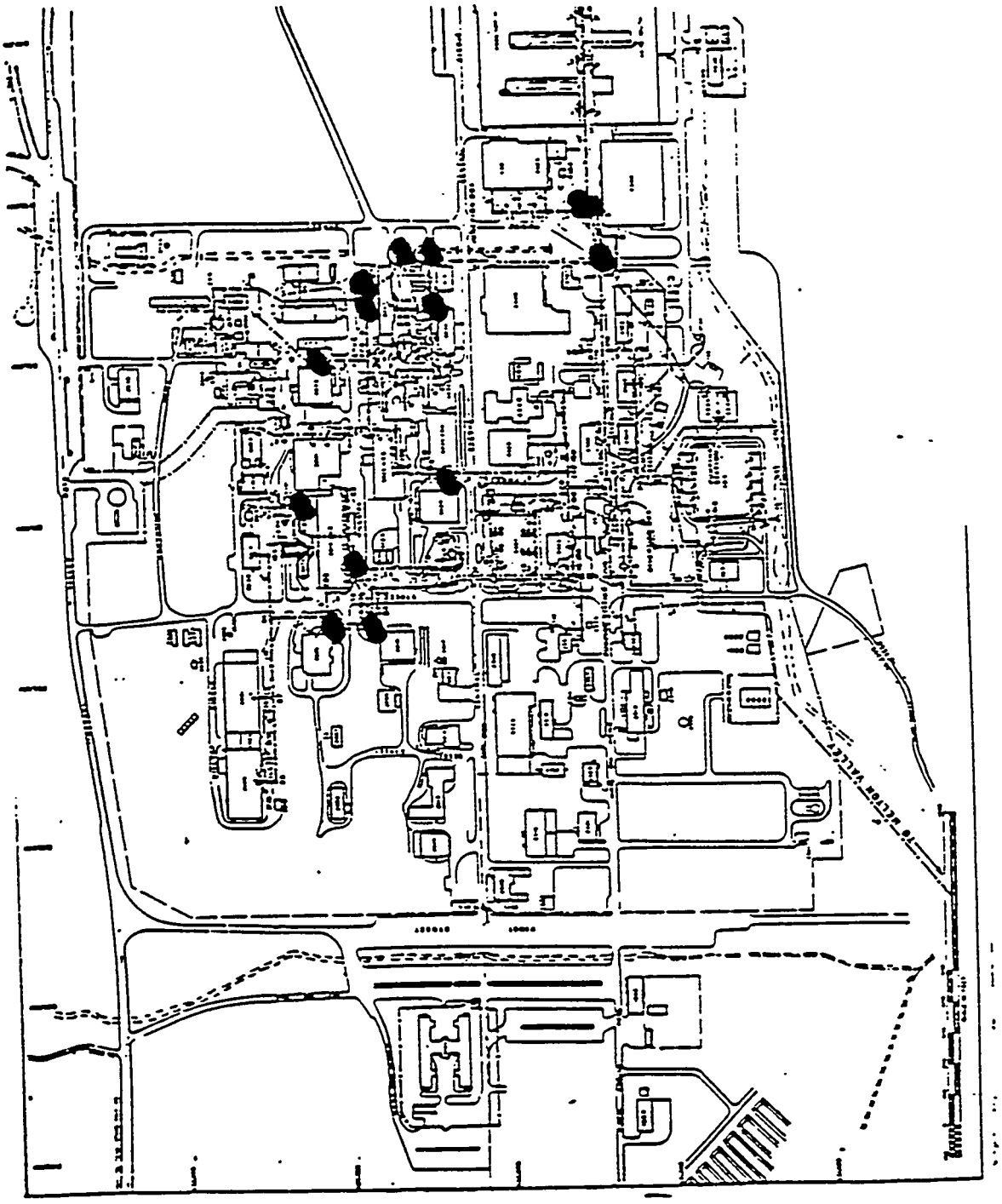


Figure 4. Planning Map
Oak Ridge National Laboratory
Bethel Valley
Process Sewer System

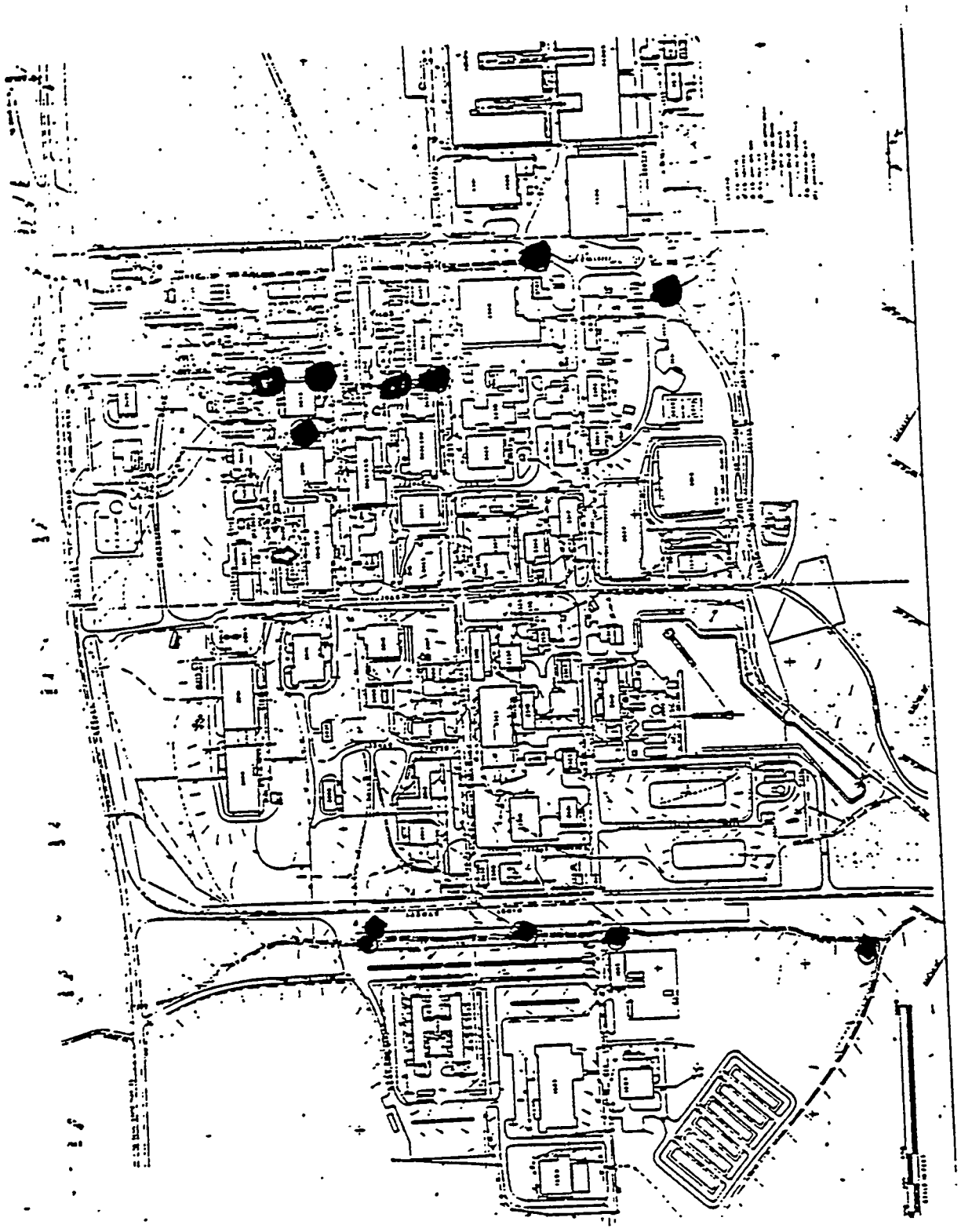


Figure 5. Storm Drains and Creek Sites

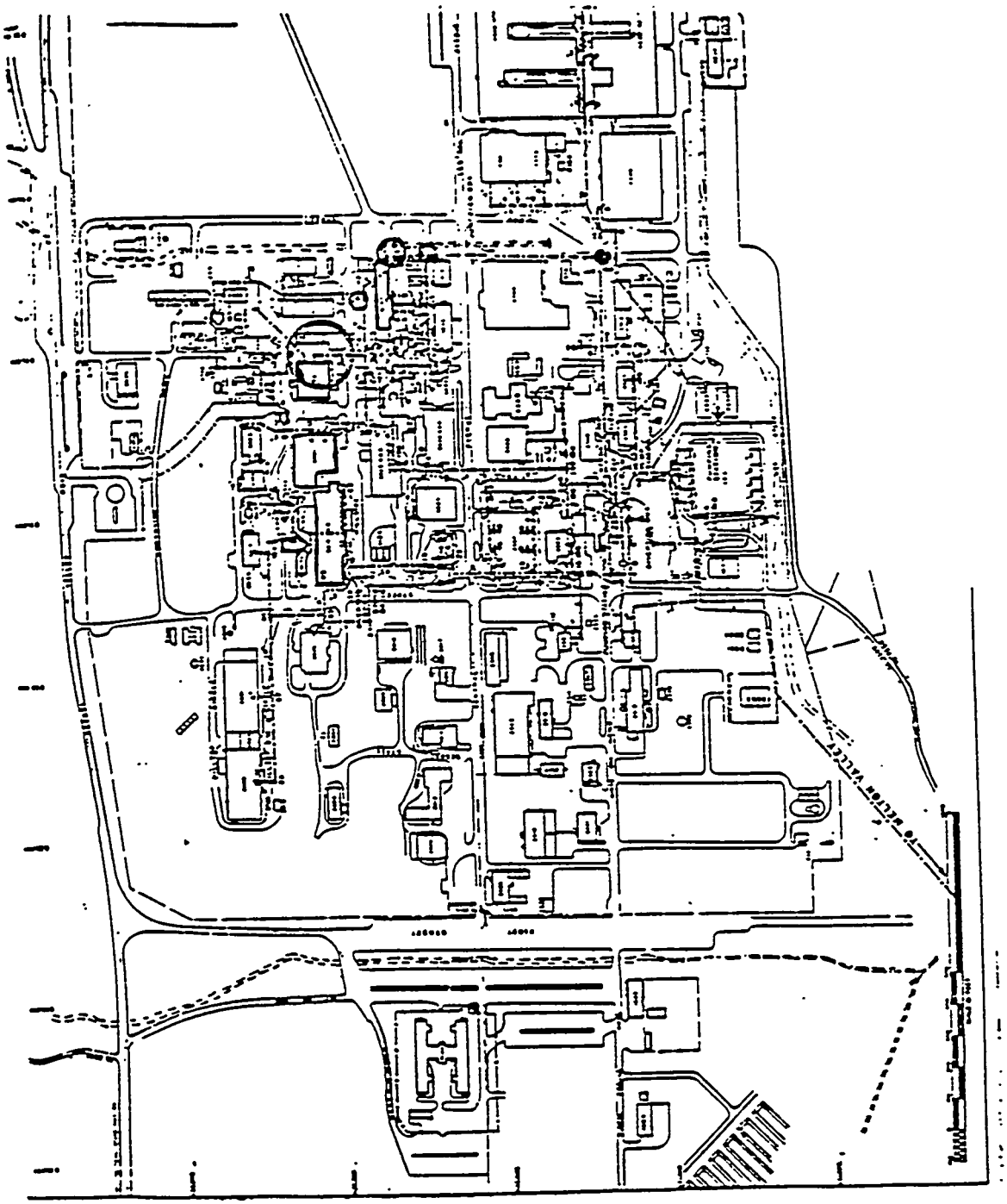


Figure 6. Planning Map
Oak Ridge National Laboratory
Bethel Valley
Process Sewer System

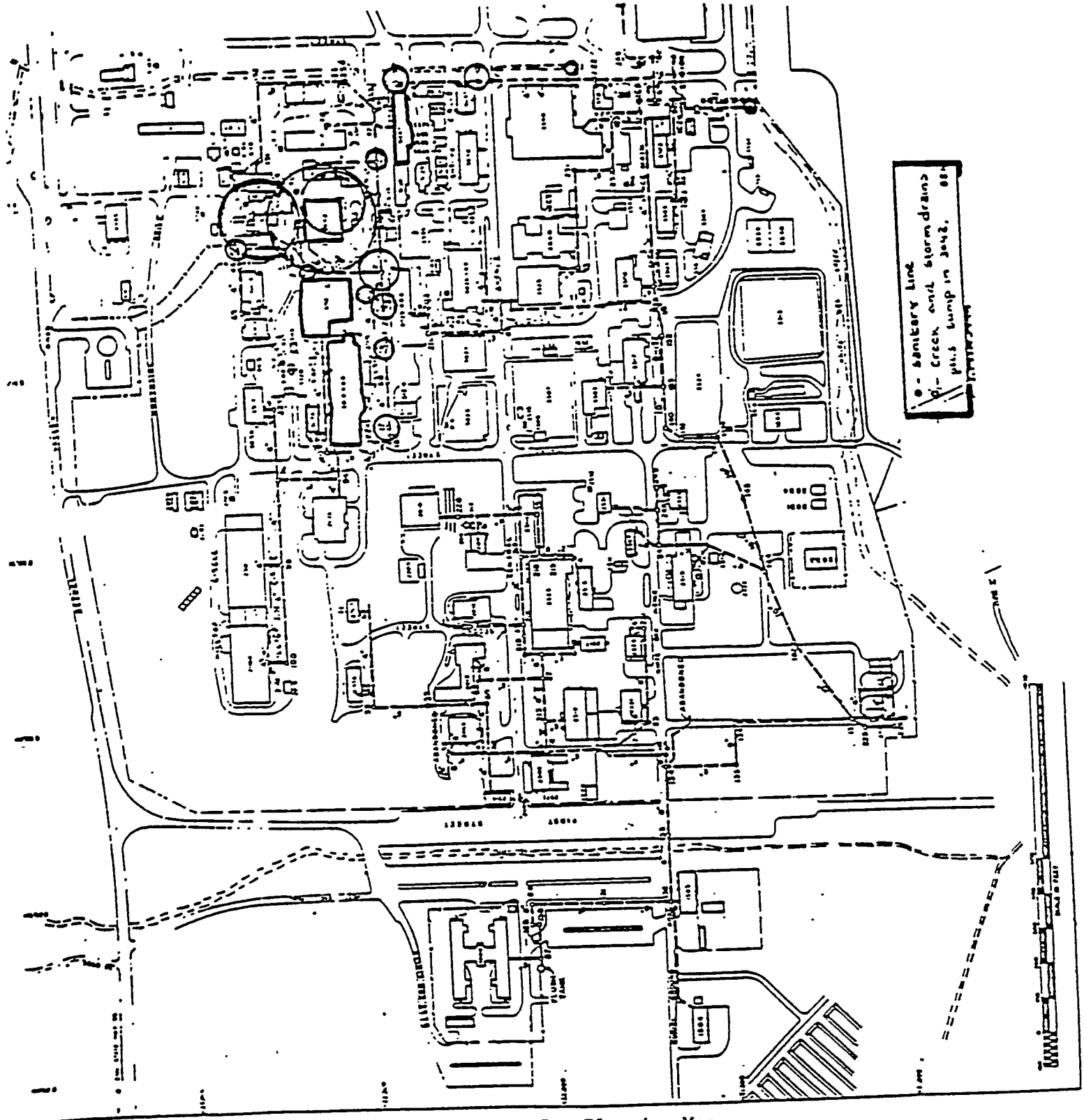


Figure 7. Planning Map
Oak Ridge National Laboratory
Bethel Valley
Sanitary Sewer System

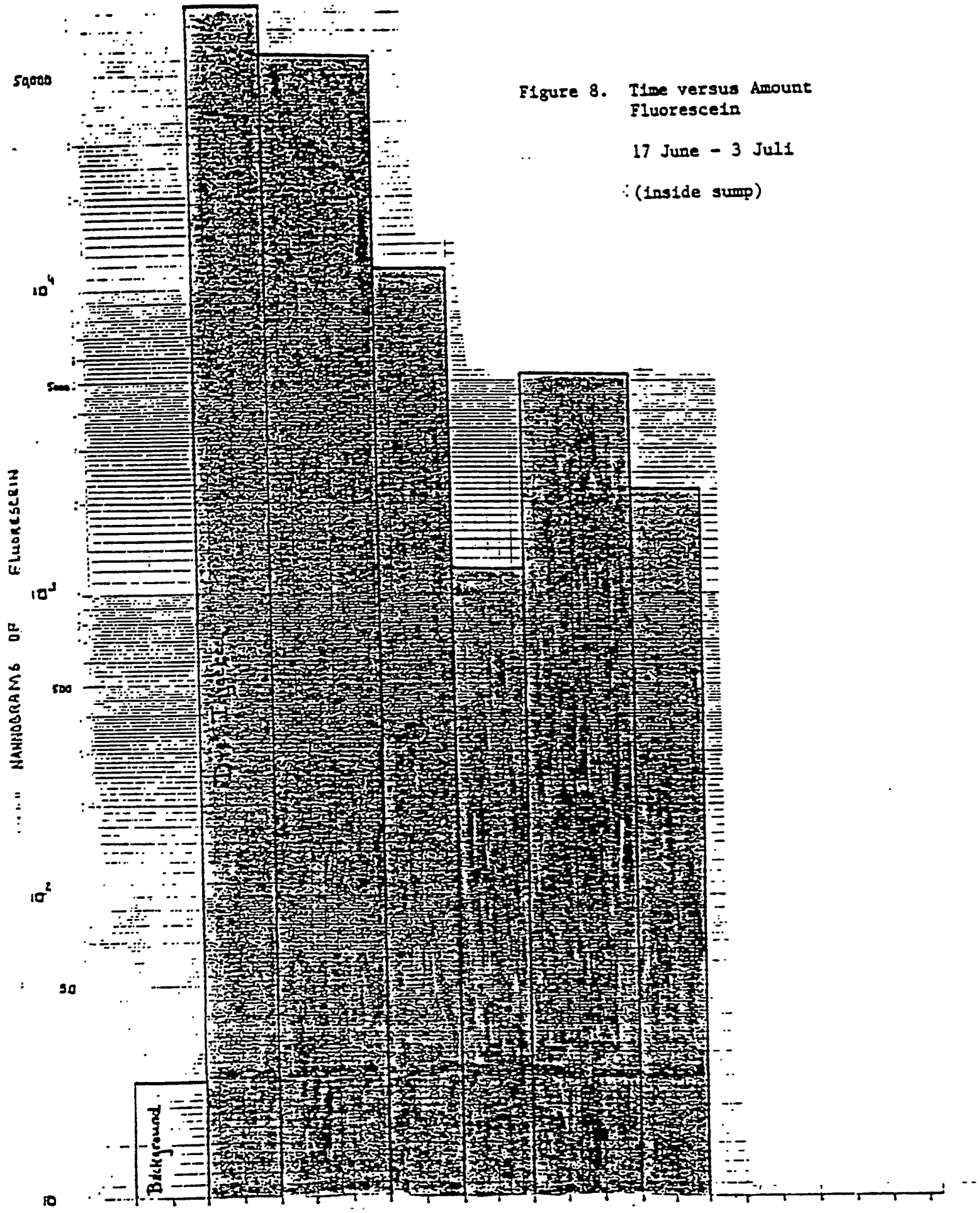


Figure 8. Time versus Amount Fluorescein

17 June - 3 Juli

(inside sump)

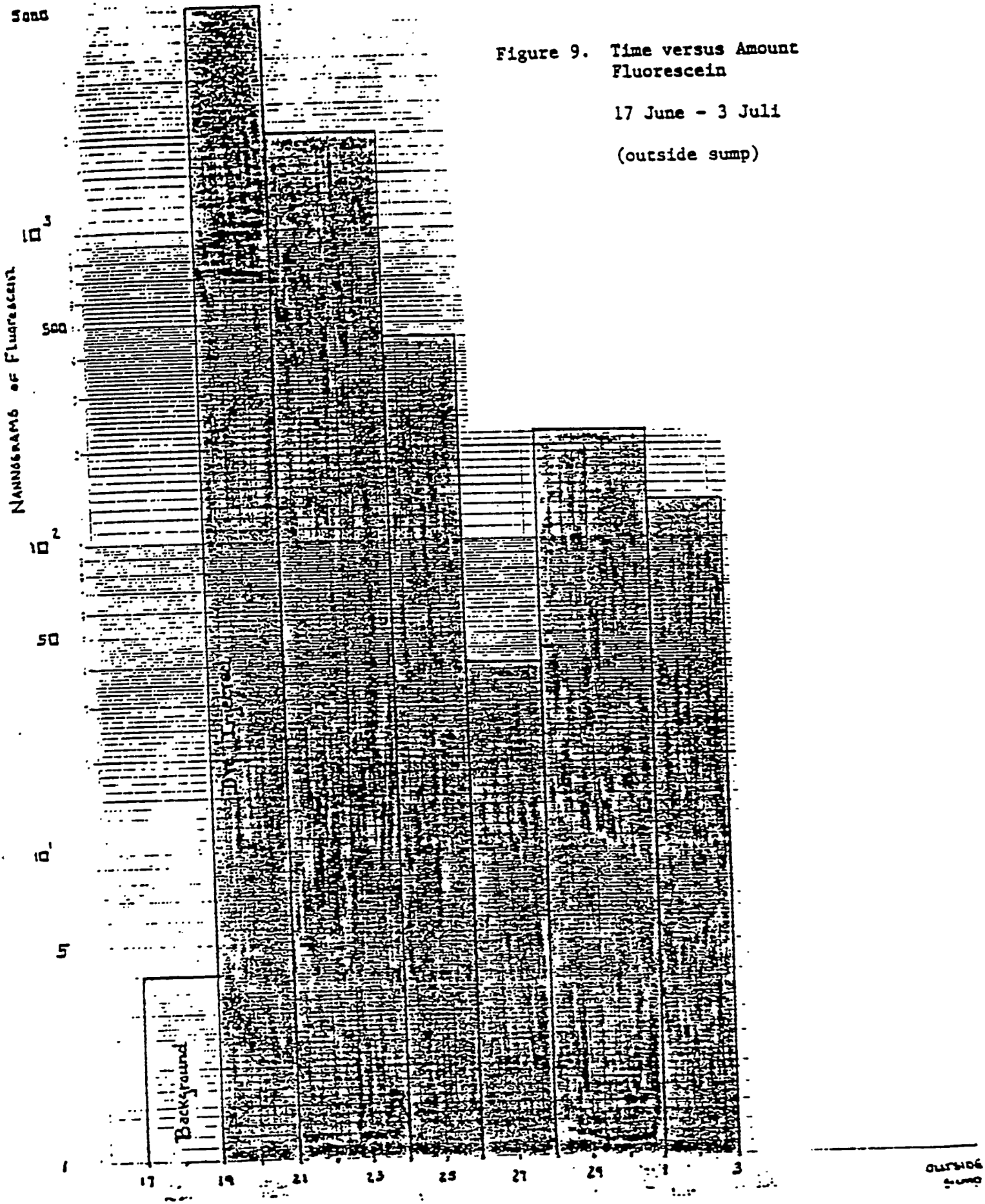


Figure 9. Time versus Amount Fluorescein

17 June - 3 Juli

(outside sump)

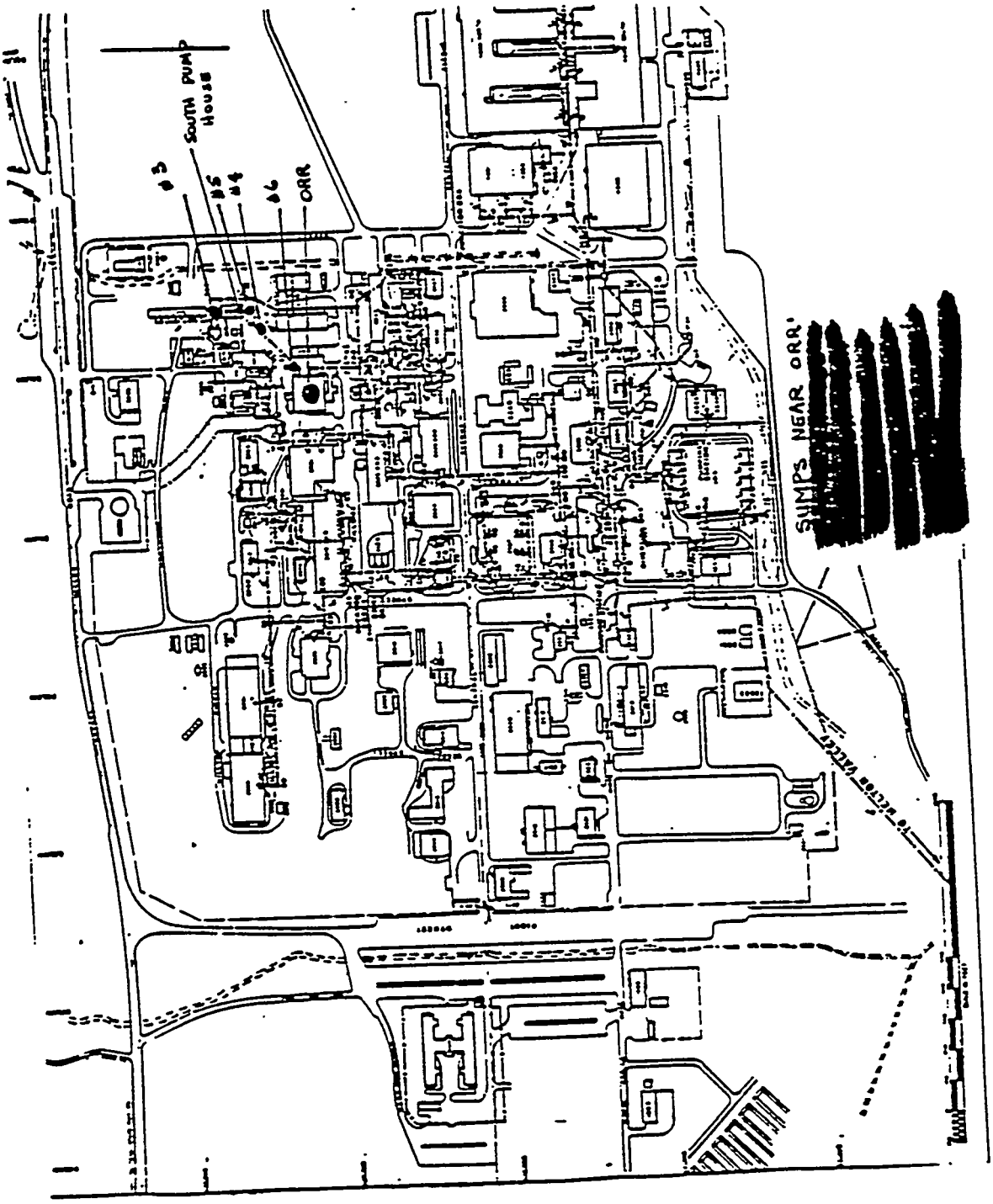


Figure 10. Sumps and Elevations

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

July 19, 1985

TO: D.E. Ferguson, 4500N

FROM: D.D. Huff /DDH/sja

SUBJECT 90-Sr Contamination Study

This is an update on the investigation to characterize possible contaminant migration from the broken low level waste transfer line near building ~~3047~~ 3074. This work was initiated following the appearance of 90-Sr in the sanitary sewer lines near building 3019 and at the sewage treatment plant in early February 1985. Initial findings implicated a process waste line and low level waste line north of building 3019. Dye tests revealed that the low level waste line was broken, with liquids from this area moving a considerable distance, as was demonstrated by dye found in the sump at building 3042. Dye was also detected south and east of building 3047. Evidence of 90-Sr at 28 feet below land surface near the southeast corner of building 3019 suggested a possibility of widespread movement of radiocontaminants.

On June 17, 1985 a detailed fluorescein dye tracer experiment began. The objective was to identify water flow directions and confirm results of a former test. The present investigation includes several points in underground lines (sanitary, process, and storm drainage). The procedure for the dye tracer study is simple and direct. Packets containing activated charcoal were placed at approximately 45 sites (some were lost during the test) within the X-10 plant area (see figures 1,2,3). Fluorescein dye was then injected into a low level waste transfer line behind building 3019 where the known break point is. To determine extent and duration of dye along the waste lines, the charcoal packets were replaced on alternate days until July 3, 1985. As charcoal packets were replaced, they were taken to the Analytical Chemistry Division for determination of the fluorescein dye content.

Although all test results are not yet available, dye was identified in the sump of building 3042 (ORR) within 48 hours. Present dry weather conditions can account for slower groundwater flow rates. However, there clearly is a direct and rapid hydraulic connection between the leak site and the ORR sump. The sump is a man-made discharge point for local groundwater which could cause a depression of the water table in the immediate area. This cone of depression could influence liquids flowing from the break in the low level waste transfer line.

In addition to the monitored waste lines, waters have been sampled along discharge zones of First Creek and Fifth Creek, to examine the possibility of 90-Sr migration. Along the geologic strike between the spill area and First Creek, there was no indication of contamination and dye amounts were negligible from the tracer test. However there was evidence of dye and of 90-Sr contamination along strike in the direction of Fifth Creek and an increase in flow in the area where two units of the Chickamauga limestone are in contact, also along strike from the spill site. Further results from the tracing test are needed to clarify whether a continuous groundwater flow path to Fifth Creek exists. A complication arises since the ORR sump pumps water into a storm sewer that drains into Fifth Creek in the area where the 90-Sr has been identified. Investigations into the flow and contaminant transport will continue and additional findings will be reported as they become available.

cc: J.H. Swanks, 3047
F.J. Homan, 3047
P.S. Rohwer, 4500
N.H. Cutshall, 1505
L.C. Lasher, 3130
W.F. Furth, 1000
M.E. Mitchell, 1000

ernal Correspondence

MARTIN MARIETTA ENERGY SYSTEMS, INC.

August 6, 1985

H. M. Butler
D. M. Bradburn
F. J. Homan
D. D. Huff
T. E. Myrick
W. F. Ohnesorge

Agenda - August 8, 1985 Meeting With Staff of Tennessee Department of Health and Environment

References: (1) W. Hibbitts to B. J. Davis, et al., "TDHE Meeting August 8, 1985," July 29, 1985.
(2) T. W. Oakes to H. M. Butler, et al., "Final Agenda - July 1, 1985 Meeting With Staff of Tennessee Department of Health and Environment," June 27, 1985.
(3) T. W. Oakes to H. M. Butler, et al., "July 1, 1985 Meeting With Staff of Tennessee Department of Public Health," June 26, 1985.
(4) W. Hibbitts to B. J. Davis, et al., "TDHE Meeting July 1, 1985," June 20, 1985.

As noted in Reference (1), the July 1 briefing of Mike Mobley and Roger Halsey [References (2)-(4)] has been rescheduled for August 8, 1985. Your office was notified on August 5, 1985, by telephone of this new date. The agenda for this meeting is attached and if you have any problems meeting at this time, please let me know.

Tom W. Oakes

T. W. Oakes, 1000, MS-214A, ORNL (6-8499) - NoRC

cc/att: W. R. Bibb, DOE
B. J. Davis, DOE
R. L. Egli, DOE
W. F. Furth
H. W. Hibbitts, DOE
D. B. Howard, DOE
T. M. Jelinek, DOE
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L. E. McNeese
M. E. Mitchell
D. C. Parzyck
H. Postma
T. H. Row
J. H. Swanks
R. S. Wiltshire
File - TWO

Resource Management Committee

H. M. Braunstein
T. R. Butz
W. W. Chance
J. T. Kitchings
J. G. Rogers

AGENDA

REVIEW MEETING WITH MIKE MOBLEY AND ROGER HALSEY TENNESSEE DEPARTMENT OF HEALTH AND ENVIRONMENT DIVISION OF RADIOLOGICAL HEALTH

MEETING PLACE	Building 1000, Room 200-C, ORNL
MEETING DATE	August 8, 1985
MEETING TIME	1:00 - 3:00 p.m.
DOE HOST*	H. Wayne Hibbitts
MARTIN MARIETTA ENERGY SYSTEMS., INC. HOST	T. W. Oakes

1:00 - 1:15	Low-Level Waste Piping Systems - Problems and Solutions	F. J. Homan
1:15 - 1:45	Health Physics Protection Program 3019/3074 and 3047 Contaminated Soil Areas	H. M. Butler, Jr.
1:45 - 2:00	Dye Studies/Groundwater 3019/3074 and 3047 Contaminated Soil Areas	D. D. Huff
2:00 - 2:15	Planned Remedial Actions for Contaminated Areas at ORNL (Non-Waste Disposal Areas)	T. E. Myrick
2:15 - 2:30	Land Farming of Sludge From City of Oak Ridge Sewage Treatment Plant	D. M. Bradburn/ W. F. Ohnesorge, Jr.

*Responsible for compliance with DOE-ORO notification requirements of ORO 5483.1.

BRIEFING

TENNESSEE DEPARTMENT OF HEALTH AND ENVIRONMENT

AUGUST 8, 1985

DYE STUDIES/GROUNDWATER

3019/3074 AREA

DYE-TRACING AND GROUNDWATER FLOW

OVERVIEW

- BACKGROUND INFORMATION
  - INCREASED ^{90}Sr TRANSPORT OBSERVED IN LATE JANUARY
  - SOURCE DETERMINED TO BE BROKEN WASTE TRANSFER LINE
  - BROKEN LINE REMOVED FROM SERVICE BUT CONFIGURED TO ALLOW FURTHER STUDY
  - STUDY INTEGRATED INTO LAB-WIDE CHARACTERIZATION WORK

- CHARACTERIZATION STUDY
  - DYE TRACING TO DEFINE AREA FOR DETAILED WORK
  - RESULTS AND NEXT STEPS

RESULTS SUMMARY

DYE DETECTED AT MORE THAN 5x BACKGROUND

- ORR SUMP
- SANITARY SEWER LINES
- STORM SEWERS NEAR ORR (SUMP DISCHARGE)

FLOW PATHWAYS

- BREAK TO ORR SUMP (SOLUTION CAVITY)
- BREAK TO SANITARY SEWER
  - OLD EXCAVATION ROUTES FOR SEWER LINES?
  - ALONG BUILDING FOUNDATION?
  - DOWN-DIP MIGRATION/UNDER BUILDING?
- NO EVIDENCE OF FLOW TO FIRST CREEK
- DYE IN FIFTH CREEK (STORM DRAIN PATHWAY)

WORKING HYPOTHESIS

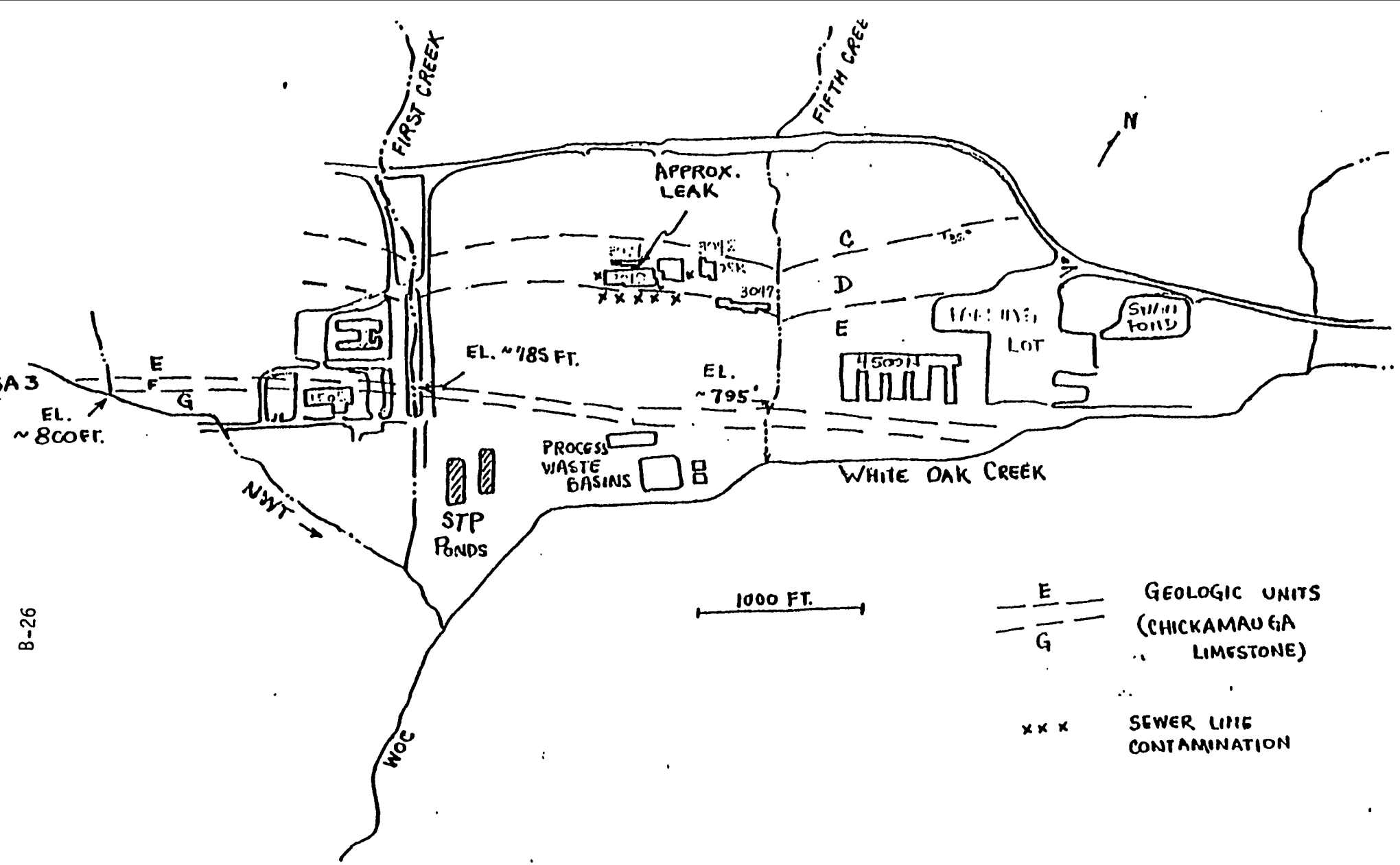
- PATH FROM BREAK/LEAK IS DOMINANTLY TO ORR SUMP
- FLUSHING IS RAPID (CAVITY FLOW LIKELY)
- UNSATURATED ZONE CONTAMINATION IS POSSIBLE
  - MIGRATION COULD INCREASE WITH HIGHER WATER-TABLE CONTAMINATION
  - ENHANCED MOVEMENT TO SANITARY SEWER LINES IN WET WEATHER

NEXT STEPS

- PLAN AND INSTALL PIEZOMETERS TO CHARACTERIZE GROUNDWATER HEAD DISTRIBUTION
  - GRADIENT TOWARD SUMP?
  - ROLE OF GEOLOGIC UNITS

- LIMITED CORING NEAR BREAK TO EVALUATE POSSIBLE ZONE OF CONTAMINANTS ABOVE SATURATED ZONE

- EVALUATE CONTAMINANT DISCHARGE AT THE ORR SUMP FOR VARYING CONDITIONS AND PLAN FOR CONTROL


FIRST CREEK
FIFTH CREEK
N
APPROX. LEAK
C
D
E
3017
EL. ~785 FT.
EL. ~795'
EL. ~800 FT.
E
F
G
PROCESS WASTE BASINS
STP PONDS
WHITE OAK CREEK
NWT
WOC
1000 FT.
E
G
GEOLOGIC UNITS (CHICKAMAUGA LIMESTONE)
SEWER LINE CONTAMINATION

B-26